SCIENCE ABSTRACTS.

Section A.—PHYSICS.

SEPTEMBER 1905.

GENERAL PHYSICS.

1671. *A Rotating Mercury Pump.* **W. Kaufmann.** (Zeitschr. Instrumentenk. 25. pp. 129–133, May, 1905.)—The chief part of the pump consists of a glass cylinder from which branch two spiral tubes coiled round the cylinder. The latter is partially filled with mercury and inclined to the vertical. Rotation of the cylinder round its axis causes the apparatus to act somewhat in the same way as a fall-pump by means of the alternate rise and fall of the mercury in the two spirals. From 200 to 250 cub. cm. of mercury are required to charge the pump, and pumping can be stopped at any stage by stopping the rotation. The pump, which is portable, can exhaust a bulb of 12 cm. diam. from 20 mm. pressure to that at which Röntgen rays begin to appear in about 12 min. For an exact idea of the construction of the pump, reference must be made to the original paper with its illustrations. G. E. A.

1672. *Determination of Angular Distance between Cross-wires of Telescope.* **N. Jadanza.** (Accad. Sci. Torino, Atti, 40. 12. pp. 527–533, 1904–1905.)—If a scale be observed at two distances D and D/*n*, and the apparent distances apart of the cross-wires as observed on this scale are S_1 and S_2, the author finds that $1/K = \left\{n/(n-1)\right\} \left\{(S_1 - S_2)/D\right\}$, where K is the cotangent of the angle subtended at the objective by the space between the cross-wire. Results are given which illustrate the accuracy of the method employed. S. G. S.

1673. *Friction in the Case of Movement of Solid Body in Contact with Plane.* **E. Daniele.** (N. Cimento, 9. pp. 174–203, March, and 289–295, April, 1905.)—The papers apply the mechanical theory of friction developed by the author [see Abstract No. 1880 (1904)] to the above problem. There are two parts to the problem ; the first is an application of the expression for the friction ρ_t of the previous paper, and the deducing of the equation for the particular force of connection "vincolo." ρ_t is then expressed as a linear function of certain parameters μ, analogous to the coefficient λ of Lagrange. The second part of the calculation is the analytical deduction of the motion in equations between μ and λ. (Ibid. pp. 266–280, April.) A further paper. S. G. S.

1674. *Distortion of Cylindrical Shell having Longitudinal Slot.* **V. Volterra.** (Accad. Lincei, Atti, 14. pp. 641–654, June 18, 1905.)—A cylindrical shell being cut parallel to the axis and the two faces of the cut caused to approach each other, the form of the shell depends on whether the faces of the cut are radial or parallel planes. The former case is studied, and the stresses at various points in the shell are found. The external layers are in extension and are concave in the longitudinal direction, the inner layers being the reverse. The external layers are shortened longitudinally and the inner layers are elongated. Photographs of a caoutchouc tube under experiment are given. The measurements made upon it are in agreement with the calculated results. S. G. S.

1675. *Slow Stretch in Indiarubber, Glass, and Metal Wires.* **P. Phillips.** (Phys. Soc., Proc. 19. pp. 491–510; Discussion, pp. 510–511, July, 1905. Phil. Mag. 9. pp. 513–531, April, 1905.)—The relation between the stretch (x) of a specimen of indiarubber and the time (t) for which a given load is applied is found to be $x = a + b \log t$, where a and b are constants for the particular pull; further, b is proportional to the pull. After the first few seconds from the application of the load this relation represents the fact with considerable accuracy. If now the load is removed, the relation $x = b \log (t/t_0)$ represents the return to the original state; x and b have the same meanings as before, t is the time from the application of the load and t_0 that from the removal. The load P which is required to maintain constant stretch is given by $P = a - b \log t$, where b is proportional to the stretch. If two loads act together, one being applied before the other, then, while t_2 is small compared with $t_1 - t_2$, the indiarubber stretches almost as though only load 2 were acting; but when t_2 becomes large compared with $t_1 - t_2$, the stretch is the same as though both loads were applied at the same instant. Glass fibres were next investigated; the apparatus is described in detail. The stretching was found to follow the same law as for indiarubber. In the case of metal wires it was found necessary to anneal all the wires under the same conditions, as otherwise the results were discordant. The law for stretching was found to be the same as that for indiarubber, the constants in the equation being much smaller. There was no slow creeping back, in the case of the metals, when the load is removed, such as was found with indiarubber and glass. The results for iron and steel wires follow no simple law; the curves for stretching are given. S. G. S.

1676. *Young's Modulus (Adiabatic) for Glass.* **C. A. Bell,** with appendix by **C. Chree.** (Phys. Soc., Proc. 19. pp. 511–524, July, 1905. Phil. Mag. 9. pp. 413–424, April, 1905.)—The glass is used in the form of rods, and the notes they emit when their ends are tapped are compared with those emitted by standard rods of steel. The frequencies of vibration of the latter are found by comparison with König standard forks. It is found that the alteration in the frequency caused by irregularities of the section may be allowed for by adding a certain length to each rod. The appendix establishes the fact theoretically and calculates the amount. Numerical results are given for seven sorts of glass. R. S. W.

1677. *Stresses in Materials Simultaneously Loaded in Several Directions.* **H. Wehage.** (Zeitschr. Vereines Deutsch. Ing. 49. pp. 1077–1080, July 1, 1905.)—Discusses theoretically the effects of simultaneous stresses in several directions upon the deformation and elastic limit of materials. The view of Poncelet, according to which two tensile stresses at right angles to one another tend to counteract one another is strongly opposed, the deformation produced under such circumstances not being regarded as a reliable criterion of the maximum stress; it is pointed out that while the two systems of load counteract one another as far as the extensions produced are concerned, their destructive effect upon the material is really superposed. Considerations are advanced to show that the behaviour of grooved tensile test-pieces, usually quoted in support of Poncelet's views, does not really confirm them. Mohr's theory, according to which the stress normal to the plane of maximum shear is alone considered, is also dealt with. In experiments on paper the present author has found confirmation of his view that the superposition of tensile stresses at right angles to one another produces an increased total load upon the material, while he cites the behaviour of wire in passing through the draw-plate as further confirmation of his views. Formulæ are given for the maximum stresses in shells of internally-stressed vessels, and also in the walls of thick-walled vessels or tubes stressed by internal pressure; in the former case the maxima are considerably higher, and in the latter case considerably lower than on the usual assumptions. W. Ros.

1678. *Effect of Hot Riveting on Rivet Steel.* **C. Frémont.** (Comptes Rendus, 141. pp. 39–40, July 3, 1905.)—The author tested samples of various kinds of rivet steels—first, without treatment; second, after heating to the usual riveting temperature, and cooling without undergoing any work; third, after being formed into a rivet, riveted whilst hot under a pressure of 25 tons, and allowed to cool under the tension due to contraction, &c. The results of the tests (tensile and impact) show that in each case the material has been decidedly improved in quality by cooling under tension. As the brittleness is not increased, it does not seem possible to account for the increase of tensile strength as an effect of the rapid cooling. **G. Charpy.** (Ibid. pp. 327–328, July 31.)—If the metal were initially in its best condition, Charpy considers that it would not be improved by riveting. F. R.

1679. *Flow of Water in Pipes.* **Dariès.** (Houille Blanche, 4. pp. 132–134, June, 1905. Nouvelles Annales de la Construction.)—A list is given of old and modern formulæ relating to the velocity of water in pipes. The fundamental equations are—

$$\frac{1}{4}DJ = \phi(U) \ \ldots\ldots\ldots\ldots\ldots (1) \quad \text{and} \quad Q = \frac{\pi}{4}D^2U \ \ldots\ldots\ldots\ldots\ldots (2)$$

where D is the diam., J the loss of head per metre, U the mean velocity, Q the amount of flow per sec., and ϕ a function. The author gives the preference to the formula of Flamant (1892): $DJ/4 = 0{\cdot}00023\sqrt[4]{U^7/D}$, for small and average diameters of pipes up to 1 m., and to that of Lévy (1868): $DJ/4 = aU^2/(1 + R^{\frac{1}{2}})$, for large sizes. Nevertheless, for diameters between 0·15 and 0·80 m. results sufficiently approximate are obtained with most of the old formulæ. The formula of Reynolds can be applied under sufficiently good conditions to all diameters. W. W. H. G.

1680. *Velocity in a Viscous Fluid.* **J. Morrow.** (Roy. Soc., Proc. Ser. A. 76. pp. 205–216, June 28, 1905.)—An expression for the velocity at which stream-line motion breaks down in cylindrical pipes has been obtained by O. Reynolds, and he with others have measured the fall of pressure occurring

in different lengths. The stability of different kinds of flow for viscous and non-viscous fluids has also been investigated, but how nearly the theoretical conditions of velocity distribution actually occur has not hitherto formed the subject of research. A delicate pressure gauge designed by Chattock and Fry has been used. The experiments provide a partial confirmation of the theoretically obtained law of velocity distribution. At the critical velocity the irrotational straight-line motion ceases and is followed by one in which the paths of the fluid particles are eddying and turbulent. The law of distribution of mean linear velocity parallel to the axis simultaneously changes from the parabolic to that of eddying motion. The author finds that the "Pitot Law" ($v = \sqrt{2gh}$) is at least approximately true at exceedingly low velocities.
W. W. H. G.

1681. *Strain Figures on Metals.* **F. Osmond** and **G. Cartaud.** (Comptes Rendus, 141. pp. 122–124, July 10, 1905.)—Upon pressing a hard needle-point against a polished specimen, series of lines, curved in the case of iron, but generally straight in other plastic cubic crystalline metals, are visible under the microscope. The authors have studied the crystallographic aspect of these lines in iron, operating upon individual crystals. On the face p of the cube a cross whose arms are parallel to the diagonals develops about the imprint of the needle-point as centre. The figures which are obtained upon the various truncations are described. The figures obtained in an ordinary polished specimen are roughly characteristic of the orientation of the grain studied, and can thus be utilised as a means of investigation of crystallographic questions (also to determine the amount of permanent strain which a specimen has undergone: other things equal, the figures are smaller on a strained than on an annealed sample) and to throw light upon the nature of the deformation of plastic crystals—it is shown, *e.g.*, that probably the crystal structure of iron is destroyed when strain is carried far enough. [See also Abstract No. 2506B (1904).] F. R.

1682. *Propagation of Waves along a Column of Compressible Liquid Filling a Horizontal Unstretched Elastic Tube.* **J. Boussinesq.** (Comptes Rendus, 141. pp. 8–13, July 3, 1905.)—The author finds that Alliévi's expression for the speed of propagation of variations of pressure along a tube, viz., $[\rho_0/k + (\rho_0/\mathrm{E})(2\mathrm{R}/\epsilon)]^{-\frac{1}{2}}$, holds even if the liquid consists of filaments moving with unequal speeds. Here ρ_0 is the normal density of the liquid, k its elasticity, ϵ, R, E, the thickness, internal radius, and longitudinal elasticity of the tube, taken to be very thin. [See Abstract No. 1245 (1904).] R. E. B.

1683. *Lateral Resistance of the Walls of an Unstretched Elastic Tube Filled with a Liquid.* **J. Boussinesq.** (Comptes Rendus, 141. pp. 81–86, July 10, 1905.)—The tube is taken to be homogeneous, but isotropic only about its longitudinal fibres, and its external surface to be free from pressure. The expression given in the preceding Abstract still holds, except that E must be multiplied by a fraction which depends on the texture of the tube and on the ratio $\epsilon/2\mathrm{R}$, and which tends towards unity as this ratio diminishes. The theory applies with a sufficient approximation to a water-pipe sunk in the ground. R. E. B.

1684. *Water Hammer.* (Eng. Rev. 12. pp. 931–933, June, 1905.)—This article gives an account of Joukovsky's experiments, in the interest of the

Moscow Waterworks, on the speeds which can safely be allowed in water-pipes of small diam., and of his analytical explanation of the phenomenon of water-hammer in all its phases. The results obtained are: (1) The shock-pressure is transmitted through the pipe with constant speed, which is independent of the intensity of the shock, but is dependent on the elasticity of the material of the pipes and upon the ratio of the thickness of their walls to the diam. (2) It is transmitted along the pipe with a constant intensity which is proportional to the destroyed velocity of flow and to its own speed of propagation. (3) Its periodical variation is due to reflection of the pressure-wave as the ends of the pipe. (4) It is influenced by continuance of flow of the water. (5) It dangerously increases when it passes from one pipe into another of smaller diam. with a dead end. (6) Pipes are best protected against it by the use of slow-closing gates, with duration of closure proportional to the length of the pipe line, and of air chambers placed near the valves and gates. [See also preceding Abstract and No. 1710 (1905).] R. E. B.

1685. *Theory of Relative Motion and Foucault's Pendulum Experiment.* **A. Denizot.** (Phys. Zeitschr. 6. pp. 342–345, June 1, 1905.)—An unmathematical account of the results of a previous paper [see Abstract No. 924 (1905)]. The general theory of Foucault's pendulum shows that its motion may be taken as dependent on gravity and two fictitious forces, a "force of transference" which is proportional to the square of the earth's angular velocity of rotation ω, and a "compound centrifugal force" which is directly proportional to ω. Since ω is small, the former force is usually neglected in the calculation, but the author declares that as the latter force changes sign with change of the pendulum's swing from forwards to backwards it cannot explain the progressive change in azimuth of the swing, which must therefore be due to the force of transference. [But the ordinary calculation shows that assumption of the latter force alone with all its changes of sign *does* explain the motion of the pendulum even in its details, viz., the ellipticity of the swing, the apsidal motion, and the direction of motion in the ellipse.]
M. P. Rudzki. (Acad. Sci. Cracovie, Bull. 3. pp. 253–254, March, 1905.)—Rudzki claims to have discovered several errors in the paper dealt with in the Abstract referred to above, which are enumerated. R. E. B.

1686. *Motion of the Boomerang.* **J. W. Sharpe.** (Phil. Mag. 10. pp. 60–67, July, 1905.)—Dynamical considerations and explanation of the motion. The axis of angular momentum (with which the instantaneous axis of rotation and the axis of the boomerang are always very closely coincident) is in each revolution displaced through a very small angle upwards to the right by the action of the components of air pressure at right angles to the line joining the horns. The other two components tend to rotate the axis back towards the thrower. The latter effect predominates. Non-returning flight is also considered. J. W. P.

1687. *Dimensions of Units.* **P. Rossi.** (N. Cimento, 9. pp. 355–374, May, 1905.)—Three fundamental units (L, M, T) are not sufficient for the whole of physics. Mass may be retained, provisionally only. If we take the ratio between the dyne and the Newtonian force between two gramme masses 1 cm. apart, we have MLT^{-2} and M^2L^{-2} as being essentially of similar dimensions, whence $[M] = L^3T^{-2}$. But the Newtonian force is itself subject to doubt. Hall proposes $d^{-2 \cdot 00000016}$ instead of d^{-2}; Seeliger, Neumann, Tisserand, have proposed other modifications. Recent electrical work points to the mass of electrons being of purely electromagnetic nature and variable with the velocity. Corpuscular theories of gravitation would lead to mass being proportional to a surface. The outcome may be a theory of mass based on the properties of the ether. Temperature cannot be expressed in terms of L, M, T; and in order to have an absolute scale of temperature we must resort to Carnot's cycle so as to obtain a definition independent of the properties of any particular substance. As to electrical units, various possibilities are discussed, and the conclusion come to that the electromagnetic constant γ should remain of no dimensions, and that the remaining fundamental unit should not be K but electrostatic quantity E, provisionally at any rate. This makes the formulæ simple, and leaves them open to future adjustment when the relation between E and M, both adopted as units provisionally only, becomes better understood. A. D.

1688. *Dynamical Theory of Gases and Radiation.* **Rayleigh.** (Nature, 72. pp. 54–55, May 18, 1905.)—The author is glad to have elicited from Jeans the clear statement given in Nature, 71. p. 607, April 27. In general outline the view of Jeans corresponds pretty closely with that expressed by O. Reynolds in a British Association discussion at Aberdeen, 1885. The various modes of molecular motion are divided into two sharply-defined groups. Within one group, including the translatory modes, equi-partition of energy is supposed to establish itself within a small fraction of a second; but between the modes of this group and those of vibration included in the other group, equi-partition may require, Jeans thinks, millions of years. Even if minutes were substituted for years, the author considers we must admit that the law of equi-partition is reconciled with all that is absolutely proved by our experiments upon specific heat, which are, indeed, somewhat rough in all cases, and especially imperfect in so far as they relate to what may happen over long intervals of time. As previously suggested, it is when we extend the application of the law of equi-partition to the modes of ethereal vibrations that the difficulties thicken, yet this extension must be made. For further information reference must be made to the original. E. H. B.

1689. *Gas Theory and Radiation.* **J. H. Jeans.** (Nature, 72. pp. 101–102, June 1, 1905.)—Rayleigh's article [see preceding Abstract] arose out of Jeans' "Theory of Gases," hence the present paper by the author of the book in reply. It is pointed out that the slowness with which energy is transferred to the quicker modes of ether vibration is a matter of calculation and not of speculation. If the average time of collision of two molecules in a gas is a great multiple N of the period of a vibration, whether of matter or of ether, then the average transfer of energy to the vibration per collision can be shown to contain a factor of the order of smallness e^{-N}. It is on this calculation and not on mere speculation that the author bases his position that the rate of transfer may be slow. Some points raised by Rayleigh are not here discussed, as fuller papers by the author on this subject are shortly to appear. E. H. B.

1690. *Partition of Energy between Matter and Ether.* **J. H. Jeans.** (Phil. Mag. 10. pp. 91–98, July, 1905.)—The question discussed in the present paper is stated at the outset by a quotation from the author's work on gases. This is followed by a highly analytical treatment of the case. In a postscript it is pointed out that in an article on the same subject recently Rayleigh had inadvertently introduced an unnecessary factor 8 by counting negative as well as positive values of the integers ξ, η, ζ [see Abstract No. 1688 (1905)]. This correction puts Rayleigh's result in accord with Planck's. [See also Abstracts Nos. 1689, 1691, and 1693 (1905).] E. H. B.

1691. *Radiation and Molecular Data.* **Rayleigh.** (Nature, 72. pp. 243–244, July 13, 1905.)—The result of a former calculation [Abstract No. 1688 (1905)] of the coefficient of complete radiation at a given absolute temperature was eight times too large, but now it has been pointed out by J. H. Jeans [see preceding Abstract] that a redundant factor was introduced. The justice of the correction is admitted. But though the result is now in agreement with Planck's, the author still wishes for a comparison of processes also. [See also Abstracts Nos. 1692, 1693 (1905).] E. H. B.

1692. *Radiation Theories Compared.* **J. H. Jeans.** (Nature, 72. pp. 293–294, July 27, 1905.)—On two occasions Rayleigh has asked for a critical comparison between the theory of radiation developed by Planck and that due to the present author; this demand is here complied with. With the greatest hesitation the author ventures to disagree in some points with Planck. These relate to the legitimacy of assigning entropy to a single resonator, and to the evaluation of a certain probability. The similarities and differences of Planck's method and the present author's may be summed up by saying that both are in effect the methods of statistical mechanics and of the theorem of equi-partition of energy, but that Jeans carries the method further than Planck. [See preceding Abstract and No. 1693 (1905).] E. H. B.

1693. *Statistical Mechanics applied to Matter and Ether.* **J. H. Jeans.** (Roy. Soc., Proc. Ser. A. 76. pp. 296–311, July 10, 1905.)—A mathematical paper in which the methods of statistical mechanics are applied to the general dynamics of matter and ether, and containing discussion of the following topics: (1) The General Method of Statistical Mechanics. (2) Application to a Holonomic Dynamical System. (3) Irreversibility. (4) Statistical Mechanics of the Ether. (5) Statistical Mechanics of Matter and Ether. (6) Radiation at a given Temperature. (7) Stefan's Law. [See also Abstracts Nos. 1688–1692 (1905).] E. H. B.

1694. *Firm Peptone Skins on a Water Surface, and the Cause of their Formation.* **M. V. Metcalf.** (Zeitschr. Phys. Chem. 52. pp. 1–54, June 9, 1905. Phys. Chem. Inst., Leipzig, March, 1905. Translation from the English.)—When peptone is dropped on water a film is formed which covers the water surface and wet portions of the glass. The strength of this film increases with time. The minimum amount of peptone required to give a firm skin is 4×10^{-7} gm. per sq. cm. In discussing his work, the author considers that the film formation is a realisation of the thermodynamic principle of Gibbs, of the production of chemical reaction under the influence of surface tension. A. F.

1695. *Diurnal Periods of Atmospheric Temperature.* **F. H. Bigelow.** (Monthly Weather Rev. 33. pp. 52–55, Feb., 1905.)—In order to decide upon the best line of work to be adopted for the new Mount Weather Meteorological Observatory, at Bluemont, Va, where common meteorology, solar radiation, atmospheric electricity, and magnetism are to be studied, the

kite and balloon observations made at Berlin, Trappes, Hald, and Blue Hill have been examined. In this paper the author deals with the records from Blue Hill, and explains the method of reduction applied for investigating the interdependence of the phenomena within the first 2 miles of our atmosphere. Several remarkable conclusions are pointed out. In the levels from 600 m. upwards there is, in the winter months, a pronounced temperature inversion throughout the day, so that the night hours are warmer, and the day hours, 6 a.m. to 6 p.m., colder than the means. The incoming short-wave radiations have little direct influence, while the long waves emitted by the earth are absorbed according to the prevailing conditions. The result is that from the 400-m. level upward, the maximum cold occurs about midday. In the summer months, June to August, this temperature inversion does not exist; the temperature curves are all of the same type, and the maximum temperature falls in the afternoon, the minimum in the early morning. In the transition months, April and May, Sept. to Nov., the diurnal temperature period has two maxima, at 8 a.m. and 8 p.m., and two minima, at 2 a.m. and 2 p.m. The process of transition can be followed in the several levels from month to month. There are thus diurnal and semi-diurnal temperature periods. At levels 400 to 600 m. the period is semi-diurnal throughout the year, with maxima at 8 or 9 a.m. and 9 to 10 p.m., distinct particularly in May and Sept. Above 800 m. the maxima are drawn nearer midday, so that two (or one) crests result, especially in winter. These temperature variations would explain the barometer variations and their resolution by Fourier series.
H. B.

1696. *Ballons Sondes sent up from the Prince of Monaco's Yacht.* **H. Hergesell.** (Comptes Rendus, 140. pp. 1569–1572, June 5, 1905.)—In April the Prince of Monaco, on the proposal of the author, sent up *ballons sondes* on a novel plan. Two balloons of rubber and a float are connected. The upper balloon serves as parachute for the lower balloon; the float hangs 50 m. below the second balloon, and is to keep the balloon afloat until the yacht has come up. Five of six ascents, made on calm days in the Mediterranean, were quite successful, and in the sixth case the outfit was afterwards recovered. The second balloon is either charged more fully so as to burst at a certain height, before the parachute, or it is automatically cut off from the parachute above, with the aid of an electric contact made by the barograph. Both the balloons were of about the same diam. (1,500 mm.). The records of the five ascents are reproduced, *e.g.*, (1) Maximum altitude 8,900 m., minimum temperature —46·3° C., duration of ascent 58 min., vertical speed up 5·6 m./sec., down 4·8. (2) Altitude 6,870 m., —36·2°, 45 min., 5·6 and 4·7 m./sec.
H. B.

1697. *The Thames Flow and British Pressure and Rainfall Changes.* **W. J. S. Lockyer.** (Nature, 72. pp. 178–180, June 22, 1905.)—Reports dealing with the flow of the Thames in relation to the rainfall of the river's basin for the period 1883 to 1903 were published during 1903 and 1904, both by the London County Council and the Thames Conservancy. Examining, together with N. Lockyer, the data from 1860 up to the present time, the author finds that air pressure, rainfall, and Thames flow are intimately related, and that the curves become strikingly similar when a lag of five months is allowed for the Thames flow, and when the pressure curves for Oxford or Armagh are inverted. Attention is further drawn to the fact that the Oxford barometer curve seems to have favoured for series of years alternately the Bombay type and the Cordaba type [see Abstract No. 2841 (1904)]. From 1900 the type of variation appears somewhat indefinite.

H. B.

1698. *Mathematical Theory of Seiches.* **Chrystal.** (Roy. Soc. Edinburgh, Trans. 41. 3. pp. 599–649, July 3, 1905. Proc. 25. pp. 328–337, 1904–1905. Abstract.)—Assuming the line of maximum lake depth to be approximately straight, and the seiches natural (not forced), the author deduces equations, whose roots Burgess and E. M. Horsburgh have assisted him to calculate, and thus general formulæ for the period T_v of the v-nodal seiche and their nodes. These formulæ are applied to lakes with symmetrical longitudinal section of parabolic concave form, parabolic convex form, and to cases of concave unsymmetric biparabolic section, and of lakes with one shallow and two maximum depths. The ratio T_2/T_1 is in the first (concave) case 0·574, and the nodes are displaced towards the shallows; when the bottom is convex the ratio is 0·474, that is to say, the period of the binodal seiche is less than half the period of the uninodal seiche; when the bottom is flat, $T_2/T_1 = 0·5$.

H. B.

1699. *Suspected Sudden Change on Jupiter.* **Molesworth.** (Roy. Astronom. Soc., Monthly Notices, May, 1905. Nature, 72. p. 207, June 29, 1905.)—While observing at Trincomalee, Ceylon, on December 17, 1903, the author sketched the features near the dark spot F87, situated on the southern edge of the south equatorial belt, this being done at 1h. 45·5m. G.M.T. At 2h. a minute white spot was noticed preceding and touching F87. Three minutes later it was quite obvious, and at 2h. 5m. had developed into a bright oblique rift only separated by a narrow streak from the dark spot. Subsequent examination of the region on Dec. 20 showed no signs of the phenomenon. The observations were made under almost perfect conditions with a 12¼ in. Calver reflector fitted with a Steinheil monocentric eyepiece magnifying 270 diameters.

C. P. B.

1700. *Seeliger's Theory of Temporary Stars.* **J. Halm.** (Roy. Soc. Edinburgh, Proc. 25. pp. 513–552, 1904–1905.)—The agreement of the Lick and Glasgow observations in respect to the cause of the multiple nature of the spectrum lines of Nova Persei is accepted as evidence that this phenomenon was not due to variations of the *internal* properties of the vibrating atoms. The only reasonable explanation left for consideration is therefore that of motion of the body in the line of sight, and this fully satisfies the chief fact that the structure of the bands was strictly in proportion to wave-length. On this basis the author has made an extended hypothesis on the lines first suggested by Seeliger, who ascribed the outburst of a new star to the collision between a dark solid body and matter of a nebular consistency. During the approach and after the contact there will have been many variations of velocity impressed on the meteoric particles while under the influence of gravitational attraction by the dark body, and though the initial velocities of the small bodies may have initially been similar, after collision these will have very variable values. The heat developed by contact will cause the star surface to liquefy or even become gaseous, and there will thus be formed an expanding atmosphere of similar nature to the solar chromosphere, but the extent of which will depend chiefly on the increase of temperature produced. Under certain conditions this temperature may reach such values as to give the gases velocities greater than the critical value for the star. Taking then the star after collision with the swarm, there will be a central photospheric radiation, surrounded with a bright-line atmosphere, all the particles of which may be regarded as moving radially outward from the star centre. All the rays leaving the photosphere from the semisphere facing the observer will thus have to pass through all the layers of the absorbing atmosphere, and we shall thus get a dark-line spectrum as well as one of bright lines from the atmosphere alone. There will, however, be the added condition that all the particles of absorbing atmosphere producing the dark lines are moving with high velocities towards the observer, and therefore all the dark lines will be relatively displaced towards the violet side of the normal position. This will be a general rule for all new stars, and has been a characteristic feature of all that have been observed up to the present time. In addition much of the after history of the development of Novæ is explained on this assumption. C. P. B.

REFERENCES.

1701. *Demonstration Apparatus.* **E. Cominotto.** (N. Cimento, 9. pp. 295–297, April, 1905.)—Hydrostatic lecture-apparatus for showing by means of a balance the equality between down-thrust and up-thrust in flotation. A. D.

1702. *Measurement of Thickness.* **S. Maresca.** (N. Cimento, 9. pp. 281–288, April, 1905.)—A falling weight and index wheel arrangement for measuring thicknesses of laminæ, from 0·5 to 1·5 mm. Tables, showing better results than with a spherometer, are given. A. D.

1703. *Isochronous Oscillations of Mercury in Communicating Tubes.* **A. Pizzarello.** (N. Cimento, 9. pp. 375–383, May, 1905.)—These oscillations are isochronous, the restitutive force being always accurately proportional to the displacement; their period depends on the diameter of the connecting tubing. Friction reduces the amplitudes, but does not affect the frequencies; it does, however, affect the form of the free surface, and thus, taken together with the sum of the superficial tensions, it prolongs one-half, while the same causes equally shorten the other half of each oscillation. A. D.

1704. *Strength of Conical Shell of Uniform Thickness.* **M. Panetti.** (Accad. Sci. Torino, Atti, 40. 6. pp. 291–319, 1904–1905.)—A mathematical discussion of the stresses in a uniform shell whose shape is a truncated cone. The limiting cases are those in which the semi-angle of the cone is zero or 90°; in the former case the cone becomes a plane circular sheet, and in the latter a cylinder. Various forms of piston are included in the former case, and in the latter the cylindrical tank. S. G. S.

1705. *Armoured Cement Beams.* **M. Greco.** (Accad. Sci. Torino, Atti, 40. 9. pp. 395–418, 1904–1905.)—Calculation of the strength of the beam in relation to the sections of cement and iron and the elastic properties of the materials used. Beams of rectangular and of T section are studied. Applications to several particular cases are given. S. G. S.

1706. *Elasticity of Rocks.* **S. Kusakabe.** (Mathematical and Physical Soc., Tokyo, 2. 22. pp. 341–352, 1905.)—This continues the work referred to in Abstract No. 5 (1905) upon the modulus of elasticity of rocks determined by a kinetic method. Results are given for 158 specimens of various Japanese rocks. J. W. P.

1707. *Strength of Concrete.* **S. E. Thompson.** (Assoc. of Engineering Societies, Journ. 34. pp. 171–205; Discussion, pp. 205–218, April, 1905.)—A very full paper with references and tables from recent work on the subject.

1708. *Tests of Concrete in Tension and Compression.* **I. H. Woolson.** (Eng. News, 53. pp. 561–566, June 1, 1905.)—Diagrams are given showing set curves, elastic curves, and total deformation curves, as well as tables of elastic moduli and breaking load, obtained from the author's tests at the Columbia University Laboratories. A later paper (Ibid. 54. pp. 35–38, July 13) deals with the effects of heat.

1709. *Strength of Columns with Fixed Ends.* **B. Kirsch.** (Zeitschr. Vereines Deutsch. Ing. 49. pp. 907–915, June 3, 1905.)—Experiments were made on wrought-iron bars 20 mm. diam., and of lengths such that (length)/(radius of inertia) $>$ 100. A 70-ton Emery testing-machine was used, and deflections were measured by means of a plumb-bob suspended from a point at the centre of the column. The effect of fixed ends in strengthening columns is found to be much smaller than has hitherto been supposed; the gain in strength supposed to arise from the fixation of the ends of columns should not be relied upon, while the serious effect of slight eccentricity of shape or of loading should be considered. These views are embodied in a formula.
W. Ros.

1710. *Hydraulic Shock in Tubes with Pressure Gauges.* **de Sparre.** (Houille Blanche, 4. pp. 104–107, May, 1905.)—An application of Alliévi's theory of the shock caused by stopping the flow of water in a pipe, to the case of a pipe furnished with a pressure-gauge. It is shown that if the ratio of the diameters of the gauge and pipe is small, the gauge has practically no effect on the shock, but that increase in the size of the gauge diminishes the shock both in intensity and duration.
R. E. B.

1711. *Lateral Vibrations of Bars.* **J. Morrow.** (Phys. Soc., Proc. 19. pp. 588–601; Discussion, pp. 601–602, July, 1905. Phil. Mag. 10. pp. 113–125, July, 1905.)—This is an analytical treatment for bars of uniform and varying cross-section, under the following heads: Clamped free bar; Bar supported at both ends; Free-free bar; Clamped free bars of varying section. The method is approximate. Comparison with Kirchoff's investigation (1879) is made.
J. W. P.

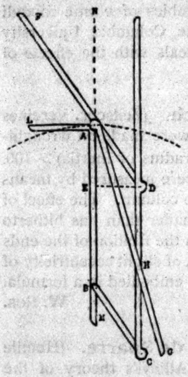
1712. *Lowering of the Temperature in Mid-June at Bucharest.* **G. G. Gheorghiu.** (Annal. Scientifiques de l'Univ. de Jassy, 3. pp. 151–166, June, 1905.)—Observations made at Bucharest confirm the marked diminution of temperature, defined by two minima separated by a maximum, noticed by Lancaster in Brussels, by Feitelson in St. Petersburg, and by Luizet at Lyons. Barometer and thermometer records are given.
L. H. W.

1713. *Cosmic Origin of the Stannern, Jonzac, vnd Juvenas Meteorites.* **G. v. Niessl.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 1361–1419, Nov., 1904.)—All available observations of these well-authenticated meteorites have been collected, and from the geographical positions of the stations and the altitudes observed approximate positions of the radiants and probable orbits of the swarms supplying the stones have been computed.
C. P. B.

1714. *Stars having Peculiar Spectra.* **E. C. Pickering.** (Astrophys. Journ. 21. pp. 292–294, April, 1905. Harvard College Observatory Circular, No. 92.)—A list of 31 stars. The star λ Cephei is interesting as being the first star discovered in the northern hemisphere showing the new spectrum found in ϕ Pappis some years ago, consisting of a second hydrogen series.
C. P. B.

LIGHT.

1715. *Instruments giving the Direction of Refracted and Reflected Light Rays.* **J. R. Milne.** (Roy. Soc. Edinburgh, Proc. 25. pp. 806–812, 1904–1905.)—The first instrument described is a linkage in the form of a parallelogram, made by jointing together four strips of metal, and having a fifth strip jointed to one corner. This strip (AG in Fig.) is graduated in terms of AD from 0·5 to 2·0. To use the linkage, the point A is brought to the point of intersection of the incident ray with the trace on the paper of the refracting surface, and AL is laid along the tangent to the surface. AF is then made to coincide with the incident ray, and the division on AG corresponding to μ is brought to the edge of CD by turning AG about A. The edge of AG then gives the direction of the ray after refraction; for if i is the angle of incidence and r the angle of refraction, $\sin i/\sin r = AH/AD = \mu$. Three other graphical methods are described. A. W.



1716. *Photographic Meridian Telescope for determining Right Ascensions.* **J. Mascart** and **W. Ebert.** (Comptes Rendus, 140. pp. 1314–1318, May 15, 1905.)—The author describes the construction and method of working of a new photographic transit designed by Lippmann and constructed by Gautier. A photographic collimator being oriented in the plane of the meridian, there is fixed before it a cylindrical mirror, of which the generatrices are normal to this plane. To obtain sufficient light a vertical slit is used at the focus of the collimator instead of a minute hole. After reflection from the mirror there will therefore be formed a plane of rays constituting a circle of reference indicating the meridian of the place. A second telescope, mounted equatorially, is then arranged to receive part of these rays and also the light from the stars. At the focal plane of this objective there will be formed an image of the meridional line of light, and the star images throughout the field. The collimator is provided with an instantaneous shutter, released every minute by a clock movement. The resulting photograph gives a scale of time on which the positions of the stars in the field may be determined by micrometric measurement. C. P. B.

1717. *Camera for Tri-colour Photography.* **E. T. Butler.** (Photographic Journ. 45. pp. 199–203; Discussion, pp. 203–204, June, 1905.)—A camera is described which, at one exposure, gives a set of tri-colour negatives. It contains two semi-transparent reflecting screens, placed at 45° to the rays from the lens, the first of which reflects a portion of the rays to the first sensitive plate; the second screen reflects a further portion of the rays to the second plate and allows those for the third plate to pass through. This third plate, being directly and therefore most strongly illuminated, receives the red, orange, and yellow rays, whilst that which receives the blue rays is placed where the weak light from the second reflector falls. Data regarding the colour screens and dyes and a simple method of printing are given. G. E. A.

1718. *An Optical Paradox.* **Rayleigh.** (Phil. Mag. 9. pp. 779–781, June, 1905.)—A point source of approximately homogeneous light is focussed by a lens upon the object-glass of a telescope which is focussed on the lens. According to geometrical optics the margin of the lens should be seen sharp by an eye applied to the telescope, but, when the limitation of aperture at the object-glass of the telescope is considered, it is concluded that the definition is very bad. Enlargement of the source, supposed self-luminous, does not improve the definition; this is attained by removal of the lens. The method of testing the effect is given, and the theoretical basis of the question is indicated. If at the object-glass a screen be interposed provided with a slit through which the image of the first slit can pass, the definition falls off greatly. This gives the clue to the weak place in the theoretical argument. **G. Johnstone Stoney.** (Ibid. 10. pp. 126–129, July.)—Comments on the above; to be published fully later. G. E. A.

1719. *Refractive Index of Lenses.* **S. D. Chalmers.** (British Optical Journ. 4. pp. 230–232, June 8, 1905. Engineering, 79. p. 765, with Discussion, June 16, 1905. Paper read at the Optical Convention, June 3, 1905.)—A method is described for determining accurately the refractive index of a lens. The lens, of index n_1 and radii of curvature R_1 and R_2, is immersed in a liquid of index n_0 not very different from n_1, contained in a vessel with plane-parallel sides. The focal length $F = (n_1 - n_0)(R_1 + R_2)$, and it is only necessary to determine the values of F, R_1, and R_2 to the degree of accuracy required for the value of $n_1 - n_0$; *e.g.*, $n_1 - n_0$ being about 0·02, an error of 1 in 200 in any of the former quantities will correspond to 1 in the fourth decimal place in the final value of n_1. The liquids used were cedar oil ($n_D = 1·517$) and oil of cloves ($n_D = 1·530$). The curvatures are measured by an Abbe spherometer or by Drysdale's method (Proc. Opt. Soc., Nov., 1900), a Beck lens-bench being employed to determine F. An accuracy of 0·0005 is obtained by the method, the errors in some cases given being much less. The method reduces or eliminates difficulties arising from spherical aberration. G. E. A.

1720. *Curvature Method of Teaching Optics.* **C. V. Drysdale.** (Phys. Soc., Proc. 19. pp. 524–551; Discussion, pp. 552–554, July, 1905. Phil. Mag. 9. pp. 467–491, April, 1905.)—The object of the paper is to show that not only are physical methods the most suitable at the outset, but that they are capable of being employed with the same increased simplicity in the whole domain of "geometrical optics." The alternative methods of attacking lens problems are enumerated as follows: (*a*) Conjugate distance method—geometrical or Gauss method; (*b*) Physical or curvature method; (*c*) Method of deviations—von Seidel, Finsterwalter; (*d*) Use of characteristic function or principle of least time—Hamilton, Thiesen, and Chalmers; (*e*) Thermodynamic method—Clausius; and Employment of the "eikonal"—Bruns; and (*f*) Vector or quaternion treatment. Of these, (*b*), (*c*), and (*d*) are the most suitable, and are also essentially similar. The practical optical units, viz., "dioptre" and prism dioptre are then defined, the optical trade having, apparently quite independently, adopted a system of lens and prism nomenclature which harmonises completely with the wave theory of light. The writer has proposed the adoption of multiples and submultiples of the dioptre, such as millidioptre and kilodioptre. Notation is then dealt with, the use of large and small letters being recommended, as in the instance where, if r_1 and r_2 are the radii of the surfaces of a lens, then the curvatures are R_1 and R_2, and

$C = R_1 - R_2$, the total curvature of the lens. The bulk of the paper is then occupied by a brief description of the various steps in the development of an elementary optical course on the curvature method. A comparative table is given of the formulæ for refracting systems, obtained by the Gauss, deviation, and curvature methods, and the subject of aberrations is held over for another paper, the application of the method, however, being illustrated by means of the case of oblique refraction in thin lenses. G. E. A.

1721. *Methods of Lens Testing.* **T. H. Blakesley.** (Engineering, 79. p. 765; with Discussion, June 16, 1905. Paper read before the Optical Convention.)—A collimator consisting of a scale of parallel lines, separated by distances in the ratio 1 : 2 : 3, placed in the principal focus of an achromatic lens, is small enough to fit a microscope stage. The lens to be tested is placed between the collimator and the microscope, and an image of the object is formed on its second principal focus. The magnification can then be measured, the principle of the method being that if an object is in the first principal focus of a lens of focal length f_1, and a second lens of focal length f_2 is applied to the issuing light at any distance from the first lens, the magnification of the resulting image is constant and its value is $(-f_2/f_1)$. The instrument may be used for determining focal lengths, radii of curvature, refractive indices, and aberrations. G. E. A.

1722. *Sensitiveness of the Eye to Colour.* **D. A. Goldhammer.** (Ann. d. Physik, 16. 4. pp. 621–652, April 11, 1905.)—The sensitiveness of the eye is expressed as the sum of three functions of the wave-lengths for maximum colour sensation, so that for totally colour-blind persons (monochromatic eyes) the expression reduces to one member, and for red-blind and green-blind persons to two members, and a formula is obtained which is tested by means of the observations of monochromatic, dichromatic, and trichromatic eyes on the brightness of the different colours of a spectrum for which the corresponding energy values are given. The formula is found to agree tolerably well with observation in all the cases investigated. [See also Abstract No. 410 (1903).] G. E. A.

1723. *Three-colour Photography.* **G. Aarland.** (Photographic Journ. 45. pp. 172–175; Discussion, pp. 175–176, May, 1905.)—The present situation as regards three-colour printing is that no process as yet indicates the ways and means of obtaining good results with certainty. Uniformity in filters is necessary, and a great step would be made if panchromatic plates could be obtained which give the luminosity values of all colours without the interpolation of filters and with short exposures. A standard set of inks is still to be desired. In the *discussion* **H. S. Ward** suggested that a committee should deal with the latter question. [See also Abstracts Nos. 335 and 527 (1905).] G. E. A.

1724. *Photographic Development.* **S. E. Sheppard** and **C. E. K. Mees.** (Roy. Soc., Proc. Ser. A. 76. pp. 217–234, June 28, 1905. Photographic Journ. 45. pp. 241–248, July, 1905.)—With constant development for short times the thickness of the layer of the gelatine in which deposit of silver occurs is independent of the exposure; with increased development the thickness rapidly increases to a maximum for each exposure; and for long development it increases somewhat with the exposure. When γ, the degree of development, is low, the size of grain of silver increases with the exposure; but with longer development the size of grain increases until at γ_∞ it is independent of the exposure. KBr lowers the size of the grain, but at γ_∞ the grain attains the same size in a bromided as in a non-bromided developer. For moderately long development the number of grains at the surface is constant; in the thickness of the film it increases with the exposure, and for moderately long development is nearly proportional to the density, the size of the grain being constant. With continued development the number of grains increases rapidly at first, then more gradually till a maximum is attained. Other things being equal, the grain of AgBr-gelatine receiving most exposure is most reactive and starts development first; and the reactivity is a steady function of the exposure. After diffusion of the developer through the gelatine comes the diffusion of it through the micro-layer, of the order 0·0005 mm., surrounding the AgBr grain. Whenever the chemical velocity approaches the velocity of diffusion in this micro-layer there will be a tendency to departure from the law of constant density-ratios. The Watkins multiple, used in ascertaining the proper time of development from the time of appearance of the density first visible, depends on the density first visible being always an equal fraction of the total density, and therefore the time of first appearance being inversely proportional to the reaction-velocity, and being similarly modified by concentration, &c.; but this can only hold for simple reactions, not for graded or catalysed reactions. With ferrous oxalate from N/5 to N/40 the time of first appearance varies inversely as the concentration. Temperature between $-0{\cdot}8°$ C. and 30° does not affect the density-ratios; and for the velocity-constant $K = \log [\gamma_\infty/(\gamma_\infty - \gamma)]/t$, $\log K = -(A/T) + C$, where T is the absolute temperature. The temperature coefficient was found to be higher than the diffusion-theory would indicate; it might be affected by the resistance of the gelatine (formaline does not generally lower the development velocity) or by the rate of penetration of the developer through the reaction micro-layer. In the film there is a gradient of reactivity and a gradient of concentration of the developer; if these are in the same direction, as in the usual case, the free surface develops first; if they are opposed, as in plates exposed at the back, the back or the front may appear first according to the amount of exposure. The temperature coefficient is an inadequate criterion for distinguishing diffusion from chemical velocity, but the action of soluble bromides, to be considered later, appears to provide such a criterion. A. D.

1725. *Homocol as a Sensitiser.* **A. J. Newton, C. E. K. Mees,** and **S. E. Sheppard.** (Photographic Journ. 45. pp. 264–267, July, 1905.)—Some measurements upon the sensitiveness of a plate bathed in this dye, showing its value for this purpose. First the absorption of aqueous and ammoniacal solutions was measured, the curves of the extinction coefficients for the various spectral regions being given. An Ilford half-tone plate was bathed in the dye and exposed in a Tallent spectroscope to a standard illumination, and the densities after development are shown plotted against wave-lengths. Finally the authors measured the ratio of blue to yellow sensitiveness (for which they suggest the symbol χ) by Eder's method, *i.e.*, exposing dyed plates to the standard light after passage through screens which (*a*) absorb all the rays below $\lambda = 4900$ and (*b*) absorb all the rays above $\lambda = 4900$. The smaller the above ratio the better the correction for colour sensitiveness. With homocol Ilford half-tone plates gave $\chi = 1{\cdot}1$ to $1{\cdot}4$; a good panchromatic plate gives $\chi = 5$ to 10, while erythrosin plates give $\chi = 12$ to 20. E. C. C. B.

1726. *Röntgen-ray Tube Investigations with a Pin-hole Camera.* **H. Gocht.** (Phys. Zeitschr. 6. pp. 354–358, June 1, 1905. Abstract of paper read before the Röntgen Congress, Berlin, April 30–May 3, 1905.)—Using a sheet-metal camera with a pin-hole ¾ mm. diam., the author has taken photographs of the Röntgen light source on the antikathode. Numerous plates taken under different conditions are reproduced. The antikathode usually makes an angle of 45° with the concave kathode. The plates show that the image of the focussed kathode rays (which is best when it is small, and circular in shape) is diffused at one side (long oval), as though the impinging rays on the antikathode had bounded off, when the plate is held normal to the latter. When the plate is at 45° to the antikathode the image is much rounder; the best position is at 65°. It is also shown that a hard tube, or one which has become hard, gives a more diffuse, less intense image. The use of a hemispherical antikathode inclined to the plate at 40° gives by far the most sharply defined and nearly circular image. Tubes with moveable antikathodes are not recommended, as they only give good results at one particular distance. L. H. W.

1727. *Earth's Motion and Speed of Light.* **M. Brillouin.** (Comptes Rendus, 140. pp. 1674–1676, June 26, 1905.)—On the supposition that the ether is immobile and the earth in movement, all theories involve an influence of the first order which is expressed either by the substitution of a local time for a general time or by the variation of the velocity of apparent propagation of light with direction. Thus on the first way of putting it we have local time = general time *minus* a term directly proportional to the speed of the earth, and inversely proportional to the square of the speed of light; while on the second plan we have, apparent speed of light = true speed — U cos θ, where U is earth's speed and θ the angle between the two directions concerned. Now, Wien and Schweitzer have recently proposed a method of comparing the two velocities of propagation of light in opposite directions by a near and a distant toothed wheel rotating so as to have the same phase at that same instant as estimated by *general* time. The present examination of this proposed method fails to discover that the experiment affords means either of determining the phase relation between the wheels or of eliminating the error likely to be incurred in estimating it. [See also Abstracts Nos. 360 and 753 (1905).] E. H. B.

1728. *Radiation-pressure on Clear Glass.* **T. H. Havelock.** (Nature, 72. p. 269, July 20, 1905.)—G. F. Hull, when claiming to have shown experimentally that the pressure on a transparent vane is equal to the difference of energy densities before and behind it [see Abstract No. 1564 (1905)], referred to a difference of views existing regarding the theory of pressure in a non-absorbing medium. The present author here points out that for the case in question the same result is obtained whether the beam of light is considered simply as a carrier of momentum or whether the pressure due to radiation is regarded as arising from a mechanical bodily force integrated throughout the material medium in which the radiation is being propagated. E. H. B.

1729. *Optical Properties of Thin Films of Iron.* **L. Houllevigue.** (Comptes Rendus, 140. pp. 1093–1095, April 17, 1905. Journ. de Physique, 4. pp. 396–412, June, 1905.)—Plane-polarised light was passed through three transparent films of iron, 24, 38, and 47 $\mu\mu$ thick, placed in a magnetic field normal to their plane, and the angles ρ and ϕ measured, ρ being the rotatory power or angle between the incident vibration and the larger axis of the emerging elliptical vibration, and ϕ the angle whose tangent is given by the ratio of the axes of the emerging vibration. In an approximately constant field the value of log tan $(45^\circ + \phi)$ is equal for the three films, and not proportional to their thickness, thus disproving Cotton's theory that the elliptic vibration is caused by a difference in the coefficient of absorption of the two inverse circular vibrations. No birefringence could be detected with films of 22, 48, and 54 $\mu\mu$ thickness, deposited by means of plane kathodes, indicating a considerable difference in molecular structure between the conical deposits studied by Kundt, and those obtained by the author. The values of ρ and ϕ for the three first-named films have been redetermined by Houllevigue and Passa (Ibid. 141. pp. 29–31, July 3), who find that ρ is proportional to the thickness of the films for all values of the magnetic field, and affords a more accurate method of determining the thickness of the films than measurement by transparency. The ellipticity $\alpha/\beta = \tan\phi$ is shown to tend towards a limit with increase of magnetic field, this being reached at about the same value as with ρ, viz., when $H = 30{,}000$. For the same field ϕ varies very little with the thickness of the film, the ellipticity of the transmitted light being evidently a surface effect. The rotatory power of the films is about the same as that of iron obtained by electrolysis, and ten times as great as that found by Kundt for galvanically deposited iron. The results are considered favourable to Righi's view that the ellipticity of the transmitted light is due to unequal reflecting power of the iron for the two inverse circular vibrations into which the incident vibration is resolved. W. H. Sı.

1730. *Magnetic Rotation of Sodium Vapour.* **R. W. Wood** and **H. W. Springsteen.** (Phys. Rev. 21. pp. 41–51, July, 1905.)—Some measurements of the magnetic rotation of sodium vapour in order to test the validity of the formula $\delta = (1/n)[a/\lambda^2 + b\lambda^2/(\lambda^2 - \lambda_m^2)^2]$. Evidently this formula represents the rotation as being positive on both sides of the absorption band. In order to obtain the sodium vapour in a sufficiently dense state, some metallic sodium was heated in a glass tube provided with plate-glass ends. The temperature was determined by a thermo-junction of iron and constantan sealed into the tube. The glass tube was placed inside a Ruhmkorff magnet, with a nicol prism at each end, the analysing one being provided with a rotating arm and scale reading to 0·1°. Some considerable difficulty was met with in obtaining sufficient illumination owing to the density of the sodium vapour, but eventually sunlight was employed, with a monochromatic illuminator for the limitation and definition of the wave-length of light employed, the light passing through the analysing nicol was examined with a two-prism spectroscope. A table of readings is given, together with the rotatory dispersion curve. In the formula given above the term a/λ^2 refers to the effects of electrons with periods in the ultra-violet. Now the dispersion of sodium vapour has been shown to be represented by the formula—

$$n^2 = 1 + b\lambda^2/(\lambda^2 - \lambda_m^2),$$

in other words, the electrons which cause the D lines are alone operative. Assuming that the rotation is only effected by these electrons, the term a/λ^2 may be neglected. The rotation formula may be written, therefore, $d = b\lambda^2/(\lambda^2 - \lambda_m)^2$. The values given by this formula are shown in the paper, and agree very well with those observed except close to the D lines, where the calculated values are mostly too low. E. C. C. B.

1731. *Absorption Spectrum of Solutions of Chrome Alum.* **E. Ferrero** and **M. Nozari.** (Accad. Sci. Torino, Atti, 40. Nos. 7. and 8. pp. 341–350, 1904–1905.)—The authors have studied by Vierordt's method (1873) the absorption spectra of solutions of chrome alum of different strengths. The solutions were examined at the ordinary temperature, and again after heating successively to 46°, 55°, &c., and then cooling down to the temperature of the air. The results are given in the form of curves and tables. The absorption spectrum presents in general a steadily increasing absorption from red to yellow, in which region of the spectrum it is a maximum; it then falls towards the green, and afterwards rises to a high value again in the violet. The maximum in the blue solutions corresponds to $\lambda = 489$; as the temperature to which the solutions are heated increases, the maximum becomes more and more displaced towards the red end of the spectrum. The displacement is scarcely perceptible for temperatures below 55°, but is very marked from 55° to 67°; at the last-named temperature the maximum corresponds with $\lambda = 497$. D. H. J.

1732. *Spectra of Terbium and other Metals of the Rare Earths.* **M. Delafontaine.** (Chem. News, 92. p. 5, July 7, 1905.)—There is little doubt that the spectrum of yttrium as recorded by Thalén and Rowland contains lines due to other elements, as in Thalén's table there are 23 lines not present in Rowland's, and 18 in Rowland's not present in Thalén's. In the present paper are given the wave-lengths of 16 lines which the author attributes to terbium. E. C. C. B.

1733. *Structure of the Series of Line and Band Spectra.* **J. Halm.** (Roy. Soc. Edinburgh, Trans. 41. 24. pp. 551–598, July 3, 1905.)—In this paper the author deals with the harmonic series of lines in both line and band spectra, and discusses the application of the formula, $1/(V_\infty - V) = a_1(m + \mu)^2 + b_1$ ...(1), in which V_∞ is the value of the oscillation-frequency when $m = \infty$, usually called the convergence frequency or the tail of the series, V the frequency of any line of any series, m a series of integers, μ a characteristic constant representing various fractional numbers, and a_1 and b_1 constants depending on the nature of the emitting substance. The above equation is a modification of a mathematical expression employed by Thiele in his investigations of the band spectra of carbon and the line series of helium. The author calls equation (1) the Rydberg-Thiele formula. In the first part of the paper the series of line spectra are dealt with, and in the second part band spectra are considered. In every single case in line spectra $\mu = p/5q$, p and q being integers. Every known case of line series has been computed and is given in the paper, and the agreement between the calculated and observed values is extraordinarily good. A comparison between the results given by the Rydberg-Thiele formula and those given by Kayser and Runge's formula shows that the former gives distinctly better values; the Rydberg-Thiele formula also supports the law of Rydberg better. Further, the Rydberg-Schuster law is represented in a distinctly better way. In the 44 series given in the paper, 19 were found to have $\mu = 0$; with the exception of Mg, Ca, and Sn all the first subordinate series belong to this group, as also does the first hydrogen series. In any such group, if we denote by V the frequency of a line in one series and by n that of a line of another series, we have $1/(V_x - V) = a_5/(n_x - n) + b_5$...(2), where a_5 and b_5 are constants and V_x and n_x are the frequencies of the xth line of the two series. An exactly similar equation holds for wave-lengths. Equation (2) enables us to calculate one series of lines by means of another belonging to the same μ-group. This the author exemplifies by calculating the wave-lengths of all the lines of the first subordinate series of In, Tl, Zn, and Li, and also the third subordinate series of He from the hydrogen series. The differences between the calculated and observed values are extraordinarily small, being in the case of He of the order of ±0·02 A.U. A still closer relation is obtained if equation (1) be written in the form $1/(V_\infty - V) = a_1[(m+\mu)^2 \pm c^2]$, $c^2 = b_1/a_1$...(3). The Rydberg-Thiele formula, it is shown, includes also the Deslandres' formula as a special case as well as the Balmer and Rydberg formulæ, and thus opens the prospect that both line and band series are comprised under the same mathematical, and probably also physical conception. The Rydberg-Thiele formula may be written in the form—

$$\lambda = \lambda_0 \Big/ \left\{1 \pm \left(\frac{m+\mu}{\gamma}\right)^2\right\} + \lambda_\infty \Big/ \left\{1 \pm \left(\frac{\gamma}{m+\mu}\right)^2\right\} \quad \text{......(5),}$$

where γ is a constant. When $\lambda_0 = 0$ then—

$$\lambda = \lambda_\infty \Big/ \left\{1 \pm \left(\frac{\gamma}{m+\mu}\right)^2\right\} \quad \text{..(6),}$$

which is identical with Rydberg's equation; it is true that up to the present there has been found no series to which the positive sign in the denominator is applicable, *i.e.*, no line series is known with its head on the violet side of the spectrum. This equation renders possible the existence of such series. If, on the other hand, $\lambda_\infty = 0$, then equation (5) becomes—

$$\lambda = \lambda_0 \Big/ \left\{1 \pm \left(\frac{m+\mu}{\gamma}\right)^2\right\} \quad \text{.........................(7),}$$

which is identical with Deslandres' formula when $\mu = 0$. In general, therefore, the wave-lengths of any line or band series appear to be made up by two terms, one satisfying the Rydberg formula (6) and the other the more general Deslandres' equation (7). In conclusion the author discusses his formula from a general standpoint. The author suggests that a band spectrum is caused by "standing waves" in the elastic system of electrons which constitute the atom. The transverse vibrations of an elastic rod (with the exception of the two lowest) can be expressed by a relation of the form, $1/(V - V_x) = a/[m+\mu)^2 - (x+\mu)^2]$...(8). If it were possible to find an elastic body of such shape and conditions that its transverse vibrations would satisfy the equation, $1/(V - V_x) = a/[(m+\mu)^2 - (x+\mu)^2] + b$...(9), where b is a constant, then these vibrations would be exactly analogous to the series of light vibrations emitted by atoms. It is very remarkable that the addition of a single constant to equation (8), the acoustic theory of which is well established, leads to the Rydberg-Thiele formula, which represents so completely all the phenomena of spectral regularities. If the three dimensions of the elastic body are altered in the same proportion, then the wave-frequencies are inversely proportional to the cube roots of the volumes. The author shows that a similar, though not quite so simple relation obtains for vibrating atoms. Finally, the author discusses the constant a_1 in his equation (1). Rydberg assumed the constancy of this for all series. The author shows that it is not constant, but varies even for the elements of one group of the periodic table. Exactly the same variations occur with the pressure displacement effects of Humphrey and Mohler. E. C. C. B.

1734. *Phosphorescent Alkaline-Earth Sulphides.* **P. Waentig.** (Zeitschr. Phys. Chem. 51. pp. 435–472, April 11, 1905. Phys. Chem. Inst. d. Univ., Leipzig, Nov., 1904.)—Klatt and Lenard and de Visser have shown that alkaline-earth sulphides are not phosphorescent except when accompanied by a heavy metal (Cu, Mn, Bi), which determines the colour of the phosphorescence, and a flux, which need be present only in small quantities. G. C. Schmidt has shown in a similar manner that phosphorescence under the influence of kathode or canal rays is dependent on the presence of Cr, Cu, or Cd in the aluminium or zinc oxide experimented with. It is also essential that the mixture should be homogeneous, and probably in the state of solid solution. Following up the work of de Visser, who obtained a non-phosphorescent barium sulphide, the author has obtained a preparation of strontium sulphide which exhibited only a very faint blue phosphorescence; this could not be due to Mn, Bi, or Cu, and was attributed to the presence of a trace of iron. Ignition in a platinum instead of a porcelain crucible produced a rose-coloured phosphorescence, probably due to a trace of Pt; this metal has not previously been regarded as a phosphophore. The intensity of the light increases with the proportion of heavy metal present, provided it is dissolved in a homogeneous state; the solubility increases with temperature, and is very small in the cold; the mixtures are therefore in the state of supersaturated solutions. The intensity of the phosphorescence is increased by raising the temperature to which the mixture is heated and by increasing the rapidity of cooling. The phosphorescent alkaline-earth sulphides pass, when rubbed, into coloured non-luminous powders (*cf.* Beilby's amorphous phase), the colour being characteristic of the alkaline-earth sulphide and independent of the heavy metal, calcium sulphide becoming flesh-coloured, strontium reddish, and barium greenish-blue. The change is accompanied by decrease of volume and absorption of energy, and the labile coloured phase passes again into the stable form with increasing rapidity as the temperature is raised. [See also Abstract No. 1958 (1904).] T. M. L.

1735. *Emission of Light by the Vapours and Salts of the Alkali Metals.* **P. Lenard.** (Ann. d. Physik, 17. 2. pp. 197–247, July 4, 1905.)—A long paper, in several sections. I. (*a*) *Coloured incandescence of fused alkali salts.*—The appearance of the coloured glow is not dependent on the presence of a flame, but the colour is observable so long as the temperature of the salt remains above the flame temperature. A great number of salts were tested, and the author concludes that all the compounds of the alkali metals dealt with, excepting the phosphate and borate, emit light, when in a glowing fluid condition, of some definite colour. The spectra (obtained with a bead of the salt on Pt wire) were all found to be continuous, but darker in some parts, the green glow of potassium, for example, observed with KI, KF, and KHO, giving a maximum in the green. Looking through a microscope, and having an incandescent gas lamp behind the flame, the colour of the bead was found to be complementary to the emission colour, according to Kirchhoff's law. The author attributes the coloured glow to the vibration of the free kathion. The anion seems to be bound, although the free Cl-, Br-, and I-ions do not appear to have any continued vibration proper to them to any appreciable extent. In the case of the fused phosphates and borates of the alkalies, the anion appears to be free, while the kathion is bound. Potassium borate gives no glow colour. (*b*) *Specific conductivity of fused potassium borate.*—A table of results is given, and the conclusion is drawn that the salt is changed on heating to the metaborate. (*c*) *Continuous ground of the flame spectra of the alkali* *metals.*—Each metal gives a distinct distribution of brightness in the continuous ground, which is independent of the acid of the introduced salt. The characteristics of the continuous ground are given for each metal, and it is found that the same ground is obtained with the oxy-hydrogen flame, using an iridium wire, as with the Bunsen flame. The author finally concludes that the continuous ground of the flame spectra of the alkalies is emitted by the metal kathion. (*d*) *Space distribution of the metal-emission in the Bunsen flame.*—By examination of the flame spectra the author finds: (1) A space separation of the different parts of the metal-emission, nearly as complete and exclusive as that in the flame of the electric arc, exists in the Bunsen flame. The principal series of lines alone exists in the outer (oxidising) sheath of the flame, without either the secondary series or the continuous ground. But the principal series is emitted much more strongly by the other parts of the flame. Most comes from the outside (M_1) of the flame-mantle (the hottest part of the flame), but for Rb and Cs the inside (M_2) of the flame-mantle (the reducing flame) probably contributes at least as much of the principal series as M_1. (2) The secondary series and the continuous ground both come from M_1, none at all coming from the outer sheath. (3) The blue cone shows with respect to the metal no peculiarity; it emits certainly nothing more than the neighbouring part M_2. (*e*) *Continuous ground and secondary series.*—Assuming for each of the five alkalies the continuous ground, whose spectral distribution was investigated [see §§ 17, 18, pp. 210–211, of original paper] with the position of the secondary series, it follows (1) that with increasing atomic weights the alkalies have the secondary series of lines, and also the continuous ground with its maximum brightness, more and more towards the red. (2) The less refrangible limits of the continuous ground can always be taken as lying where the secondary series of lines, which increase in sharpness and at the same time in distance with diminished refrangibility, no longer run into one another. (*f*) *Relation between emission of light and electric migration in flames and arcs.*—The migration in flames has been described before [Abstract No. 650 (1903)]. Similar phenomena with the electric arc are described, and it is shown that the emission of the continuous ground or of the secondary series lines, on the one hand, and electric migration on the other, are inseparably connected with one another. It is also shown that the emission-centres of the principal series of lines are electrically neutral, while for the emission-centres of the secondary series and of the continuous ground the flame has a positive charge. II. From his researches the author deduces some theoretical conclusions. (1) The emission-centres of the principal series of lines are metallic atoms electrically neutral. (2) The emission-centres of the secondary series lines are positively-charged metallic atoms, *i.e.*, such as have lost a negative primary charge. These conclusions are developed at some length, and the paper concludes with a theory of the formation of emission-centres in flames and arcs. A. W.

1736. *Electrification by Radium Radiations.* **A. Righi.** (Accad. Lincei, Atti, 14. pp. 556–559, May 21, 1905. N. Cimento, 10. pp. 13–17, July, 1905.)—Radium emits α-, β-, and γ-rays, of which the α-rays are usually absorbed, and the γ-rays produce little effect in inducing secondary rays; the production of secondary rays by the impact of radium rays on a body is therefore due mainly to the β component of these. The secondary rays set up resemble the β component of the incident radium rays in consisting of negative electrons. The impact of negative electrons tends to charge the body negatively; the emission of negative electrons tends to charge it positively; the former effect generally predominates, and negative charges ensue; while Röntgen rays *in vacuo*, and ultra-violet rays at ordinary pressures, result in positive charges. If the body impinged upon be not thin enough to allow the β-radiations to pass through it wholly or in part, the negative charges are greater the smaller the atomic weight of the substance (element) impinged upon. Greater negative charges correspond to smaller emissions of secondary rays; or, the higher the atomic weight the greater the emission of secondary rays. If the body impinged upon be extremely thin (gold-leaf, aluminium film) the incident β-radiations traverse it and there is no appreciable negative charge. A. D.

1737. *Radio-activity of Thorium.* **O. Sackur.** (Ber. Deut. Chem. Gesell. 38. pp. 1756–1761, May 6, 1905. Chem. News, 91. pp. 271–272, June 16, 1905.)—During the fractionation of radium-barium bromide from thorianite Hahn obtained a radio-active body giving the same reactions as thorium and the rare earths. This gave a strong emanation, and was thought to be identical with Giesel's actinium, but the measurements of Hahn in conjunction with the author's showed that the emanation decayed to half value in 52–55 sec. in place of 3·6 sec. The value for thorium is 51–54 sec., and the two emanations appear to be identical. The power of emanation of this body is, however, 250,000 times as great as that of thorium. Two explanations may be given: either the body isolated is the element which confers activity on an otherwise inactive thorium, or there may be two elements which independently give rise to the same emanation. The former view is supported by the preparation by Hofmann and Zerban, and by Baskerville and Zerban, of inactive thorium, and by the fact that Hahn's element can only be isolated from a mineral containing up to 78 per cent. ThO_2, but the author was not able to separate this element from any of the commercial preparations of thorium, or even permanently to reduce its activity. T. M. L.

1738. *Radio-active Matter in the Atmosphere.* **A. S. Eve.** (Phil. Mag. 10. pp. 98–112, July, 1905.)—From experiments carried out at Montreal the author derives the following general conclusions: (1) An estimate of the amount of radium required to maintain a steady supply of the emanation in 1 cub. km. of air near the earth's surface lies between 0·14 and 0·49 gm. (2) This amount of emanation and its successive products cause a production of ions at the rate of about 9·6 per cub. cm. per sec. (3) The radium emanation in the air is probably sufficient to account wholly for the natural ionisation observed in large closed vessels consisting of non-radio-active materials, and for the rate of production of the ions in the atmosphere near the earth. (4) The collecting distance of a wire charged to − 10,000 volts is about 40 to 80 cm. The active matter derived from the carriers is not drawn in appreciable quantities from still air at a greater distance. (5) Assuming that the radium in the earth is equally distributed in amounts sufficient to maintain the temperature gradients actually observed in the earth, then the radium emanation in the air is derived from an average depth estimated to be between 5 and 17 m.
J. J. S.

1739. *Induced Thorium Activity at Göttingen.* **J. E. Burbank.** (Phys. Zeitschr. 6. pp. 436–438, July 15, 1905. Translation from the English.)—The induced radio-activity of a negatively-charged wire exposed in the open air for some hours shows a rate of decay quite different from induced radium activity. The activity reaches half value in about 11 hours, the same as for induced thorium activity. In the experiments a copper wire was used, charged by a Wimshurst machine to a potential of about — 6,000 volts, and was exposed for different lengths of time, the positive pole being earthed. Observations were carried out with Elster-Geitel apparatus and with Gerdien's new electroscope [see Abstract No. 1796 (1905)], with which latter the rate of loss was only about 0·7 volt per hour. Tables are given and decay curves plotted. The values are compared with those for induced radium activity, and the conclusion is drawn that certainly a part of the induced activity is due to thorium. A. W.

1740. *Decay Constant of the Emanations of Emanium and Actinium.* **O. Hahn** and **O. Sackur.** (Ber. Deut. Chem. Gesell. 38. pp. 1943–1946, May 20, 1905. Chem. News, 92. pp. 49–50, Aug. 4, 1905.)—Seven series of experiments on the rate of decay of the emanation from Giesel's emanium, after correcting for the induced activity, gave for the time in which the activity fell to half the mean value 3·6 sec., the decay constant being therefore $\log_e 2/3{\cdot}6 = 0{\cdot}19$. The corresponding figures found for Debierne's actinium were 3·9 sec. and 0·21, agreeing with Debierne's own measurements, and the two emanations therefore appear to be identical. For the rate of decay of the induced radioactivity the half-periods found were 36·5 min. for Debierne's actinium and 36·4 min. for Giesel's emanium. Since these two substances produce the same emanation and the same induced activity it is probable that they are identical. T. M. L.

1741. *New Radiation produced in Atmospheric Air by the Rays of Radiotellurium.* **B. Walter.** (Ann. d. Physik, 17. 2. pp. 367–374, July 4, 1905. Phys. Staatslaboratorium, Hamburg, April, 1905.)—A bare photographic plate was covered by a 7 mm. thick lead plate, in which three square holes were cut and covered with (1) Al-foil 0·0091 mm. thick, (2) glass 0·15 mm. thick, (3) Pt-foil 0·0023 mm. thick. When exposed for 20 hours in a dark room beneath a copper rod coated with radio-tellurium, an intense image was produced under the glass only, showing that a second type of radiation, distinct from the α-rays and similar to light, was present. The shadow of a steel wire stretched over the three holes was much less distinct in the case of the bright image under the glass than in the case of the feeble image (due to α-rays) under the platinum, and it is therefore argued that the source of the light-like radiation was not the copper rod but the atmospheric air, emitting a secondary radiation under the action of the α-rays. A series of absorption experiments showed that the secondary radiation was in the ultraviolet part of the spectrum, and probably consisted of an emission band ranging from $\lambda = 350$ to 290, and reaching a maximum at $\lambda = 300$. Similar experiments in a vacuum (0·002 mm. Hg) gave a much more intense Becquerel radiation, but practically no light-rays. A negative result was also obtained when the radio-tellurium was surrounded with water. When surrounded with different gases the intensity of the secondary radiation was as follows: Nitrogen, 100; air, 28; carbon dioxide, 8; nitrous oxide, 5; coal gas, 5; oxygen, 4; hydrogen, 2·3. The radiation is therefore mainly due to nitrogen, but the effect of removing the oxygen of the air is so remarkable as to demand further experiments to confirm and explain the result. T. M. L.

1742. *Electrification of an Insulated Conductor placed inside a Metallic Cylinder containing Air and communicating with the Ground.* **J. J. Borgmann.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 5. (Physical Part) pp. 159–171, 1905.)—The author continued his experiments through the academic year 1904–5, to show that a brass wire well-insulated and placed inside a metallic cylinder, acquires in time an electric charge [see Abstract No. 1580 (1905)]. The results may be summarised as follows: (1) In every case, when one pair of the quadrants of a Dolezalek electrometer was connected with earth and the other pair to the insulated wire, the needle of the electrometer (kept at 100 volts) deviated negatively, just as if a negative charge had been communicated to the insulated quadrants. The deviation persisted for some hours. (2) The maximum deviation was almost the same in all the experiments in which the distance between the surface of the needle and that of the quadrants remained the same. (3) When the electrometer was connected with the insulated wire placed in a metallic cylinder connected with earth, the limit of deviation of the needle of the electrometer depended on the nature of the cylinder surrounding the wire. When a cylinder of lead, brass, zinc, aluminium, or tin, or a double cylinder (of fine brass mesh-work) containing dried mud from Liman Konialnitz, Saki, or Berdiansk was employed, the deviation was always positive; with a copper or iron cylinder or a brass mesh-work cylinder holding Arensbourg mud the deviation was negative, but the deviation was *less* than that observed when the electrometer was not connected with the wire; when a cylinder of coke was used or a cylinder of Soupsa (Caucasus) or Pernan mud, negative deviations were observed *greater* than those obtained when the electrometer was not connected with the wire. (4) If we suppose that the deviation of the needle of the electrometer depends (*a*) on the electric charge communicated to the wire, (*b*) on the special effect in the electrometer itself, and then eliminate the second of these influences, we find that the metals lead, tin, zinc, aluminium, brass, copper, iron, and muds from Liman Konialnitzk, Saki, Berdiansk, and Arensbourg, produce negative electricity in the wire they surround, while Soupsa and Pernan muds produce positive electricity. (5) The interval of time between the insulation of the wire and the attainment of the maximum deviation of the needle of the electrometer, is longer in the case of air freshly admitted to the cylinder than when the air has been left shut up in the cylinder for some days. The difference does not depend on the difference in the ionisation of the air in the two cases. (6) On simply leaving the air in the cylinder, in time an increase of the limiting values of the charge communicated to the wire is observed. All these results can be explained by the supposition that in the air enclosed in the earthed cylinder electrification is produced by the α- or β-rays emitted from the surface of the cylinder. If this hypothesis is justified the cause of atmospheric electrification can be very simply explained.

D. H. J.

REFERENCES.

1743. *Stereoscopic Views of Objects and their Reflected Images.* **C. Pulfrich.** (Zeitschr. Instrumentenk. 25. pp. 93–96, April, 1905. Communication from the Optical Workshops of Carl Zeiss.)—Photographs of a landscape taken (1) direct, and (2) by reflection from a large mirror such as the surface of a smooth lake or canal, will, when considered together, be capable of giving a stereoscopic picture, the distance between the apparent view points being $2h$, where h is the height of the camera lens above the water mirror level.

C. P. B.

1744. *Flicker Photometry.* **H. Krüss.** (Zeitschr. Instrumentenk. 25. pp. 98–101, April, 1905.)—In referring to a photometer recently described [see Abstract No. 966 (1905)] the author recalls his own, of which he gives illustrations [see Abstract No. 1062 (1904)]. With certain alterations the head of the Lummer-Brodhun photometer may be adapted for use as a flicker photometer. Bechstein's results have not advanced the solution farther than those of Rood, the problem being to prove that flicker value and physiological brightness are the same. The question of the duration of the light impression is then considered. G. E. A.

1745. *Tangential Irradiation.* **A. Guébhard.** (Comptes Rendus, 140. pp. 1446–1449, May 29, 1905.)—The development of a black centre within the white irradiation image (positive) of a circular aperture is ascribed to tangential irradiation, which, in its action on the sensitive salt, is different to the normal irradiation described by Abney. G. E. A.

1746. *Colour in Platinum Films.* **I. Stone.** (Phys. Rev. 21. pp. 27–40, July, 1905.)—Experimental conditions for obtaining colours in thin films of platinum deposited on glass by kathodic discharge. Forms assumed by the deposit: structure of it. The changes in colour depend not on the size but on the grouping of the particles. A. D.

1747. *Refraction due to a Cylindrical Shell.* **E. Gatti.** (Accad. Sci. Torino, Atti, 40. 12. pp. 568–582, 1904–1905.)—The path of a ray travelling normally to the axis is found for various angles of incidence, and it is shown that there are three different angles of incidence at which a ray will travel through the cylindrical shell and on emergence follow the path which it would have done had there been no refracting cylinder present. S. G. S.

1748. *Double Refraction.* **F. Braun.** (Ann. d. Physik, 17. 2. pp. 364–366, July 4, 1905. Phys. Inst., Strassburg, April 16, 1905.)—Double refraction in an isotropic stratified medium is considered. The treatment is the optical analogue to the similar investigation for electric waves given in Abstract No. 1638 (1904). J. W. P.

1749. *Secondary Standards of Light.* **J. Violle.** (Internat. Elect. Congress, Trans. 1. pp. 357–364, 1904.)

1750. *Unobtained Wave-lengths between Longest Thermal and Shortest Electric Waves.* **E. F. Nichols.** (Internat. Elect. Congress, Trans. 1. pp. 438–442, 1904. Electrician, 54. p. 58, Oct. 28, 1904. Abstract.)

1751. *Relation between Mass and Weight for Radium.* **J. J. Thomson.** (Internat. Elect. Congress, Trans. 1. pp. 234–241; Discussion, p. 241, 1904.)

1752. *Interference Points.* **E. Gehrcke.** (Deutsch. Phys. Gesell., Verh. 7. 13. pp. 236–240, July 15, 1905. Physikal. Techn. Reichsanstalt, Charlottenburg, June, 1905.)—The author uses two interference apparatus, such as the plane-parallel glass plate or the echelon grating, and sets one at right angles to the other, with the result that a series of interference points are obtained. These are more satisfactory for the study of spectral lines, as the resolving power may be much increased, while the value of $\Delta\lambda$ between two successive interfering waves remains the same. E. C. C. B.

1753. *Spectrum of Giesel's Emanium.* **J. Hartmann.** (Phys. Zeitschr. 6. pp. 401–402, July 1, 1905. Astrophys. Observatorium, Potsdam, May, 1905.)—A more accurate determination of the wave-lengths of the lines of this spectrum than the author found possible in his earlier communication [see Abstract No. 3192 (1904)]. E. C. C. B.

HEAT.

1754. *Expansion and Density of Various Gases at High Temperatures: Determination of their Molecular Weights.* **A. Jaquerod** and **F. L. Perrot.** (Comptes Rendus, 140. pp. 1542–1544, June 5, 1905.)—The authors use nitrogen as normal thermometric gas and the melting-point of gold, 1067·4°, as their working temperature. The coefficients of expansion, at constant volume, of different gases between 0° and 1067·4° are found to be as follows:—

	Initial Pressure at 0°.	Coefficient of Expansion.		Initial Pressure at 0°.	Coefficient of Expansion.
Nitrogen	240 mm.	0·0036643	Carbonic oxide	230 mm.	0·0036648
Air	230 „	0·0036643	Carbon dioxide	240 „	0·0036756
Oxygen	180–230 „	0·0036652	Carbon dioxide	170 „	0·0036713

From these numbers the densities and molecular weights of these gases at 1067·4° are calculated by Berthelot's method to be:—

	Weight per Litre at 0° and 760 mm.	Weight per Litre at 1067·4° and 760 mm.	Mol. Wt. at 1067·4°.
Oxygen...............	1·42893 gm.	0·29071 gm.	32
Nitrogen	1·25045 „	0·25451 „	28·0155
Carbonic oxide ...	1·25025 „	0·25445 „	28·009
Carbon dioxide ...	1·97677 „	0·39966 „	43·992

The value obtained for carbon dioxide shows that its dissociation at 1067° is less than 1/5000. T. H. P.

1755. *Temperature of Solutions Heated by Free Steam.* **T. Steel.** (Soc. Chem. Ind., Journ. 24. pp. 606–608; Discussion, p. 608, June 15, 1905. Paper read before the Sydney Section.)—The author describes an apparatus used by him to measure the temperature assumed by salt solutions into which free steam is passed. Although the steam, when it enters the liquid, is at 99·2–99·8°, the temperature of the solution is raised approximately to its boiling-point; thus a strong solution of ammonium nitrate rises to 163·0°, the boiling-point over a lamp being 164°. If steam is passed on to the dry salt, a saturated solution is obtained containing an excess of the salt in suspension and having a final temperature higher than the boiling-point; in this case the heating effect is doubtless aided by the heat of solution of the salt. The explanation of these phenomena is that steam at the boiling-point of water has a higher vapour pressure than a saline solution, and so condenses in the latter, and continues to do so as long as the solution has a lower vapour pressure, *i.e.*, as long as it is not at its boiling-point. When this point is reached the steam merely blows through the liquid, a sufficient quantity condensing to replace the heat lost by radiation. T. H. P.

1756. *The Thermo-couple as a Means of Determining the Lowest Temperatures.* **J. Dewar.** (Roy. Soc., Proc. Ser. A. 76. pp. 316–325, July 10, 1905. Amer. Journ. Sci. 20. pp. 153–156, Aug., 1905.)—An investigation of the applicability of the thermo-electric junction to the determination of very low temperatures. A German silver-platinum couple was employed, and it was found necessary to immerse the couples in liquid air, then to heat them rapidly and again cool them in liquid hydrogen before calibration. A series of observations were made, starting with the pair of temperatures 0° and 15° C., and ending with boiling hydrogen and solid hydrogen at 20 mm. pressure ; the last temperature was unknown. Graphical extrapolation gave for the solid hydrogen under reduced pressure 14°·15 abs., while three equations duly corrected gave 15°·27, 14°·7, and 13°·5, of which the last has the least probable error. The hydrogen gas thermometer gave 14°·34, which confirms the reliability of the thermo-junction. It is probable also that the junction will accurately record temperatures to as low as 5° or 6° abs., the boiling-point of helium.

E. C. C. B.

1757. *Studies with the Liquid Hydrogen and Air Calorimeters.* **J. Dewar.** (Roy. Soc., Proc. Ser. A, 76. pp. 325–340, July 10, 1905. Amer. Journ. Sci. 20. pp. 152–153, Aug., 1905. Extract.)—In the first part of this paper the author gives the results of a number of determinations of the specific heats of many substances by means of the liquid-hydrogen and liquid-air calorimeters, in which the volume of gas liberated at a constant temperature on dropping in a known weight of substance is measured. Various sources of error are discussed, and further check experiments were carried out with lead. The specific heats of diamond, graphite, and ice were found to be as follows :—

	18° to − 78°	− 78° to − 188°	− 188° to − 252°·5
Diamond...	0·0794	0·0190	0·0043
Graphite ...	0·1341	0·0599	0·0133
Ice	0·463 (from − 18° to − 78°)	0·285	0·146

The specific heats of a number of substances down to − 188° are also given, as determined with the liquid-air calorimeter. The second part of the paper deals with latent heats; for the gases, oxygen, nitrogen, and hydrogen, the values are 51·15, 50·4, and 123·1 respectively. The latent heat of hydrogen was calculated from Clapeyron's equation to be 120·3 or 119, depending on the value used for *dp/dt* ; these values are very near to the value obtained experimentally. In the case of nitrogen and hydrogen similarly close values are obtained from the vapour-pressure observations. The latent heat of liquid air is also dealt with, and the difficulty of obtaining correct values, owing to the varying composition of liquid and vapour, pointed out. The author for old air (high oxygen content) obtained 49·7, and says that the latent heat of liquid air containing a great deal of oxygen requires further investigation.

E. C. C. B.

REFERENCE.

1758. *Production of very Low Temperatures.* (Engineer, 99. pp. 540–541, June 2 ; 566–569, June 9, and pp. 590–592, June 16, 1905.)—An illustrated description of the complete plant for the liquefaction of hydrogen, sent out by the Royal Commission for the St. Louis Exhibition. Illustrations are also given of Travers' liquid hydrogen apparatus.

SOUND.

1759. *Musical Acoustics.* **G. Zambiasi.** (N. Cimento, 9. pp. 241–265, April, 1905.)—The whole theory of physiological acoustics can be greatly simplified. The interval between two notes of frequencies an and bn is an/bn: if we reduce this to a/b we lose sight of the pitch; and n indicates how often the cycle recurs per sec., in which a vibrations of the one sound are executed simultaneously with b of the other. This cycle is the same as that which would work out one of Lissajous' figures; and such cycles recur with frequency n per sec., and have corresponding periods of $1/n$ sec. Then this frequency n is the greatest common divisor of the frequencies an, bn, ...; and the period of each cycle is the least common multiple of the periods of the component vibrations. For example: In the chord whose frequencies are n, $\frac{5}{4}n$, $\frac{3}{2}n$, and $2n$, the frequency of recurrence of a Lissajous cycle (due to four components instead of two) would be $n/4$, the greatest common divisor; and during each such cycle the respective component oscillations would respectively be completely executed 4 times, 5, 6, and 8 times. If we take the harmonic series $n, 2n, 3n, 4n, \ldots$, the greatest common divisor is n, and all consecutive pairs of notes in such a series together give Lissajous cycles, the frequency of whose recurrence is n, the same as that of the simple vibration of the fundamental tone of the series. If we take the scale n, $\frac{9}{8}n$, $\frac{5}{4}n$, $\frac{4}{3}n$, $\frac{3}{2}n$, $\frac{5}{3}n$, $\frac{15}{8}$, and $2n$, pairing each note of the scale successively with the tonic note n, we find the least common divisors to be successively $n/8$, $n/4$, $n/3$, $n/2$, $n/3$, $n/8$, and n; and the corresponding periods of the respective Lissajous cycles are, in seconds, the reciprocals of these, that is, 8, 4, 3, 2, 3, 8, and 1 times the period of the fundamental tone. Tones of the harmonic series may blend so as only to form a *timbre;* but in chords there must, for musical purposes, be sufficient blending to make the resultant sensation continuous, but not sufficient to reduce the chord to a mere *timbre* of its fundamental tone. In the chord $n : \frac{5}{4}n : \frac{3}{2}n$, the period of the Lissajous cycle for the whole chord is 4 times that of the vibrations of the fundamental tone, *i.e.*, it is $4/n$; between the first and the second of these notes it is $4/n$, between the first and the third it is $2/n$, between the second and the third it is $4/n$, which is 5 times the period of the lower of these two notes. No other combination of three tones gives shorter Lissajous cycle periods than these. As to audition, we have it that a sensation takes about $\frac{1}{15}$ sec. to come to its full; impulses fewer than about 16 per sec. do not produce the sensation of a continuous sound, and for those below 130 per. sec. the sensation produced is obscure. Sound is heard as smooth and continuous when its impulses reach the ear not less often than about 10 or oftener than about 166 times during the $\frac{1}{15}$ sec. in question; and the maximum clearness stands at 39·1 times, or say 600 vibrations per sec. Smoothness in harmony follows a precisely similar law, but this time we have to do with the recurrences of the Lissajous cycles. We cannot recognise the interval of a major third as being such, in harmony, when the pitch of it is below 80 and 100 vibrations per sec.; at that pitch we get 20 cycle-recurrences per sec., but below that pitch the sensation is obscure. The interval of a fifth can be recognised at lower pitches than this (36 and 54), but at high pitches it is sooner blurred, its cycle-recurrences being more frequent than those of the major third. If a fundamental tone have 600 vibrations per sec., it will produce 40 vibrational impulses during $\frac{1}{15}$ sec., and if its octave be sounded with it the cycle-recurrences will be 40 per sec. and the consonance will be absolute; if its fifth, the cycle-recurrences are 20 per sec., consonance perfect; if its fourth or major sixth, 13⅓ per sec.; if its major third, 10 per sec. and consonances medium; if its minor third or minor sixth, 8 per sec., consonances imperfect; and if its major second, then only 5 per sec., a dissonance. The same acoustic interval may thus be dissonant at low and consonant at high pitches; which is the case. The aural perception of an interval slightly out of tune (say 301/200) as being approximately say 3/2 is closely analogous to the optical illusion caused by its image on the screen; for about two-thirds of the time it appears to be a 3/2 Lissajous figure mobile on the screen. If the physiological constant, $\frac{1}{15}$ sec., were to alter, the whole possibilities of music would change. Relations of the theory to questions of tonality in music are discussed; mental reference is always made to a fundamental tone, the keynote. A. D.

1760. *Combination Tones.* **K. L. Schaefer.** (Ann. d. Physik, 17. 3. pp. 572–583, July 18, 1905. Psycholog. Inst. d. Univ., Berlin.)—According to Helmholtz, combinations have no objective existence outside the ear unless the primaries are produced by the same instrument. In further extension of his work on interruption tones, produced by interrupting a tone in the telephone in a regular manner [see Abstract No. 1721 (1904)], the author attempted to decide the question as to whether combination tones heard when two primaries sound simultaneously in the telephone have any objective reality outside the ear. He used a stentor microphone and stentor telephone made by Mix and Genest, and worked them with a battery giving 11·2 volts and a steady current of 0·3 amp. Both with tuning-forks and with organ-pipes he obtained objective summation tones and difference tones, reinforced by resonators properly tuned. He found, however, that the seat of these tones was the telephone diaphragm. Membranes and diaphragms have the general property of producing combination tones out of primaries, and Helmholtz's assertion that they originate in the ear is a special case of this general property. E. E. F.

1761. *Minimum Audible Sound.* **P. E. Shaw.** (Roy. Soc., Proc. Ser. A. 76. pp. 360–366, Aug. 4, 1905.)—The amplitude of the vibrations of a telephone diaphragm is investigated by means of the author's electric micrometer, with a view to finding the amplitude corresponding to the least audible impulsive sound. The value found is $0{\cdot}7\,\mu\mu$, given a sensitive ear and a telephone of the usual construction whose diaphragm fundamental is about 580. This value compares well with Rayleigh's values of $0{\cdot}05\,\mu\mu$ to $1{\cdot}3\,\mu\mu$ for minimum continuous sounds. The author determined first the displacements produced by a series of steady telephone currents; then, employing the same currents, he determined at what point the click due to the release of the diaphragm became inaudible. The following amplitudes for sounds of various intensities are given: Just audible, 0·7; comfortably loud, 50; uncomfortably loud, 1,000; and overpowering, 5,000 $\mu\mu$. The amplitudes of air molecules for the same sounds are 1/5 of the above. The greatest known amplitude, giving the loudest sound, is 1/4 mm., that being the amplitude within 2 yards of the muzzle of a gun when fired. E. E. F.

1762. *Movement of Tuning-forks.* **M. T. Edelmann.** (Phys. Zeitschr. 6. pp. 445–450, July 15, 1905.)—The author points out the essential difference in the construction of tuning-forks of the old and the new patterns. The old forks have an elastic arch at the junction with the stem, whereas in the modern ones this arch is replaced by a rigid block. The advantage of the latter is that there are fewer overtones and that the sound lasts longer. The author proves that the stem undergoes longitudinal oscillations in both patterns, and attributes the more permanent sound of the modern pattern to the greater homogeneity and symmetry now attainable. In both patterns the note emitted by the prongs is an octave below that emitted by the stem. This rule does not apply to forks so loaded that the centre of gravity of the prong is outside the prong and away from the axis of the fork. E. E. F.

1763. *Monochord Vibration Curves.* **E. H. Barton** and **C. A. B. Garrett.** (Phil. Mag. 10. pp. 149–157, July, 1905.)—The notes heard from a monochord are not directly produced by the string, but are first transmitted to the bridges, and they in turn move the belly, sides, and back of the sound-box, and the air within the box pulsates in response. To compare the quality of the note emitted by the string direct with that of the note emitted by the belly, the authors took simultaneous photographs of both. The string motion was photographed by a modification of the method devised by Krigar-Menzel and Raps in 1892, the revolving cylinder being replaced by a plate shot along on rails. The motions of the belly were studied by means of a three-legged optical lever. The photographs in no case show the zigzag curves for the motions of the belly. These are only shown when the string is bowed. In most cases the belly adds harmonics to the original note, and these come out clearly in the photographs. One of the string curves shows crinkles. The note corresponding to this curve was badly bowed, and "whistled." E. E. F.

1764. *Water-jets and Combination Tones.* **P. E. Belas.** (Roy. Dublin Soc., Proc. 10. 32. pp. 360–365; note by **W. F. Barrett,** pp. 366–372, June 9, 1905.)—When two tuning-forks of different pitches, say 384 and 512, are applied to the orifice of a sensitive water-jet impinging on a membrane, a note of frequency 128 is heard—the pitch of the difference tone [see Abstract No. 2099 (1904)]. It may be isolated by substituting a telephone diaphragm for the membrane, and listening at the far end of the line. The author succeeded in photographing the jet as influenced by the two forks separately and by both together. In the case of the 384 fork, the drops near the orifice were separated by 2 cm. In the case of the 512 fork, the distance was 1·5 cm., these distances being proportional to the vibration periods. With both forks sounding together there was a series of large drops 6 cm. apart, due to the difference tone, and between these a group of three smaller drops. Barrett points out that here we have a case of objectively real combination tones produced by feeble sources of sound, and therefore not covered by Helmholtz's theory for powerful sources. It corroborates the objectivity of combination tones as claimed by Rücker and Edser. [See also Abstract No. 1825 (1900).] E. E. F.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1765. *Atmospheric Electricity in High Latitudes.* **G. C. Simpson.** (Roy. Soc., Phil. Trans. 205. pp. 61–97, July 28, 1905. Roy. Soc., Proc. Ser. A. 76. pp. 160–164, May 24, 1905. Abstract. Phys. Zeitschr. 6. pp. 270–272, May 1, 1905.)—The author took continued observations during one year in the Lapp village of Karasjok, 129 m. above sea-level, 200 miles south of the North Cape. The potential gradient (Benndorf self-registering electrometer) rises, as in the northern hemisphere in general, rapidly from Oct. to Feb., falls rapidly till May, and keeps constant afterwards; the course of the dissipation (Elster-Geitel instrument) is exactly opposite. The potential gradient has one daily period throughout the year, maximum at 9 p.m., minimum at 5 a.m. The dissipation values of the morning hours are higher than the midday values in winter and spring; in summer and autumn the midday values are slightly higher, and the evening values lowest. The ionisation (Ebert apparatus) has not a well-pronounced daily period, but is generally slightly lower in the evening than at midday and in the morning. Low ionisations and dissipations are accompanied by high potential gradients, and *vice versâ.* For any given wind strength the dissipation is a linear function of the ionisation. With falling temperature both ionisation and dissipation become much smaller. With rising relative humidity the dissipation falls rapidly and $q = a - / a +$ increases. No connection whatever could be discovered between auroræ and the electrical condition of the atmosphere. The radio-activity (Elster-Geitel method) has a distinct connection with the meteorological condition of the atmosphere. It has a maximum in midwinter, a minimum in midsummer, and a maximum early in the morning, and a minimum about midday. At Hammerfest, observations were made for four weeks; the radio-activity was considerably lower than at Karasjok, and air from the sea proved much less radio-active than the air brought up by the land winds from the south. The radio-activity increases as the thermometer and the barometer fall and with the relative humidity, and decreases with increasing wind strength; this supports Elster and Geitel's opinion that the soil is the source of the radio-activity. Rapid circulation decreases the radio-activity of the lower atmosphere. H. B.

DISCHARGE AND OSCILLATIONS.

1766. *Electric Arc in Vacuum.* **C. D. Child.** (Phys. Rev. 20. pp. 364–378, June, 1905.)—Experiments are made with electrodes of various kinds, at pressures from 200 mm. to 0·02 mm., both air and hydrogen being used. The following are a few of the conclusions drawn: With copper and iron no arc can be maintained at pressures less than 1 mm. unless the oxide is present on the kathode. With graphite as kathode the phenomenon is independent of the nature of the anode. Employing an e.m.f. of 100 volts and a graphite anode, the arc cannot be maintained at pressures below 1 mm. when the kathode is a metal of high melting-point, but it could with a metal of low melting-point. The potential drop at anode and kathode was also investigated, and in some of the experiments an alternating e.m.f. was employed. [See also Abstract No. 156 (1905).] S. G. S.

1767. *Structure of Ions formed in Gases at High Pressure.* **O. W. Richardson.** (Phil. Mag. 10. pp. 177–179, July, 1905.)—Langevin has shown [see Abstract No. 503 (1905)] that the slow diffusion of ions through gases renders it necessary to assign to the positive and negative ions diameters equal respectively to thrice and twice that of the uncharged molecule. Langevin's observations may be quantitatively interpreted by assuming that the negative ions which occur at high pressures and have a velocity of 504 cm. per sec. under a field of 1 electrostatic unit per cm. at atmospheric pressure, dissociate as the pressure is reduced. They then give rise to two molecules of gas and a smaller negative ion which would have a velocity of 670 cm. per sec. under the same field if it could exist in air at atmospheric pressure. The actual velocity at any pressure is the average for the actual numbers of the two kinds that occur. The positive ions do not appear to dissociate until the pressure falls to 7 cm. T. M. L.

1768. *Evolution of Hydrogen from the Kathode and its Absorption by the Anode in Gases.* **C. A. Skinner.** (Phys. Rev. 21. pp. 1–15, July, 1905. Read in part before the Amer. Physical Soc. at Philadelphia, Dec., 1904.) —Some experiments upon the discharge through helium under reduced pressure between electrodes of different metal, which show that the kathode, when new, always forms a source of hydrogen; further, the experiments show that during the passage of the discharge the hydrogen is absorbed by the anode. Some quantitative measurements with a McLeod gauge of the amount of hydrogen evolved and with a milliammeter of the current passing, show that Faraday's electrolytic law is obeyed, and similar measurements show that the same is true for the absorption of the hydrogen by the anode. The author claims that these experiments prove that the negative ion of hydrogen must be of atomic dimensions, and that as long as the supply of hydrogen in the kathode lasts, the discharge from the kathode must take place entirely by means of negatively-charged hydrogen atoms. E. C. C. B.

1769. *Measurement of Wave-length of Electrical Oscillations.* **E. Gehrcke.** (Elektrotechn. Zeitschr. 26. pp. 697–700, July 27, 1905. Communication from the Physikal. Techn. Reichsanstalt. Écl. Électr. 44. pp. 356–359, Sept. 2, 1905.)—The subject of wave-length measurement of electrical oscillations has been examined by the Reichsanstalt for the purpose of providing standards from which other wavemeters may be calibrated. Drude's method [see Abstracts Nos. 826 (1903) and 948B (1904)] was employed, and the Slaby multiplying rod chosen as standard wavemeter on account of its simplicity, handiness, and freedom from liability to alter in time or through handling. Drude's recent experiments [Abstract No. 1043 (1905)] dealt only with short waves; his experiments are here repeated and extended to the case of longer waves as used in wireless telegraphy (up to $\lambda = 520$ m.). Full particulars of the arrangement of the apparatus employed are given. The influence of neighbouring bodies (earthed and not earthed) on the resonance was found to be negligible, except in one case when thick wood was placed between the parallel wires (λ decreased by about 5 per cent.). A number of different multiplying rods were tested, and the values for $\lambda/4$ (actual, and those given by Slaby) tabulated. The corrections required, which were given by Slaby as < 1 per cent., are shown to be ± 1, 2, and 5 per cent. in the rods examined. The poor results in the last case are attributed to the use of coarse crystals of the platinocyanide at the tip of the rod, the insensitiveness of which led to there being an increased damping effect.

The substitution of helium tubes with alkali electrodes is suggested as providing a means of diminishing the small damping which takes place in all cases. L. H. W.

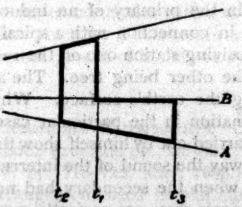
ELECTRICAL PROPERTIES AND INSTRUMENTS.

1770. *Measurement of Output of Spark Coils.* **Wertheim-Salomonson.** (Phys. Zeitschr. 6. pp. 364–365, June 1, 1905. Abstract of paper read before the Röntgen Congress, Berlin, April 30–May 3, 1905.)—The author has made experiments to determine the ratio of the energy used in Röntgen ray production to the actually produced energy of the Röntgen radiation, measuring (1) the primary energy supplied; (2) that generated in the secondary, by means of a colorimetric method; and (3) the energy of the Röntgen rays themselves, the latter by photographic means, by comparing the darkening produced by other light sources. The following values were obtained for average working of the coil:—

Loss with mechanical break		48–50 per cent.
Loss with Wehnelt break		68–73 ,,
Röntgen light with mechanical break	equivalent to	0·0426 Hefner c.p.
Röntgen light with Wehnelt break	,,	0·024 ,,

L. H. W.

1771. *Thermoelectric Circuit of Three Metals.* **H. E. Schmitz.** (Phys. Zeitschr. 6. pp. 443–445, July 15, 1905. Abstract. Écl. Électr. 44. pp. 385–386, Sept. 9, 1905.)—If a thermoelectric circuit is made up of three metals, A, B, and C, and $(AB)_0^t$ is put for the thermoelectric force when the junctions are at 0° and t° respectively, and if the thermoelectric forces are governed by quadratic expressions of the form $(BC)_0^t = a_1t + \frac{1}{2}b_1t^2$; $(CA)_0^t = a_2t + \frac{1}{2}b_2t^2$; $(AB)_0^t = a_3t + \frac{1}{2}b_3t^2$, the author shows that for different temperatures t_1, t_2, t_3 of the three junctions the thermoelectric force is—



$$E = a_1(t_1 - t_2) + a_3(t_3 - t_2) + \tfrac{1}{2}b_1(t_1^2 - t_2^2) + \tfrac{1}{2}b_3(t_3^2 - t_2^2).$$

If a_1, a_3, b_1, b_3 are all positive, and $t_3 > t_1 > t_2$, the thermoelectric force is represented by the thick-lined area in the diagram. The author corroborates these equations by experimental data obtained with a copper-iron-German silver combination, and obtains a satisfactory agreement. E. E. F.

1772. *E.M.F. and Reversible Heat-effects of Electric Circuits.* **A. Szarvassi.** (Ann. d. Physik, 17. 2. pp. 248–284, July 4, 1905. Brünner Habilitationsschrift.)—The first part of the paper deals with thermo-electricity, and numerous tables are given of the results of experiments by different investigators with various metallic couples, and also of the constants in the ordinary equations relating to the Peltier and Thomson effects. According to the theory of Kohlrausch, the seat of the e.m.f. in thermo-elements is to be sought only in the temperature fall. There are, however, possible e.m.f.'s at the points of contact of the different conductors, which do not show on account of the magnitude of the Peltier effect; and these may give rise to no production of heat at all, but only show some transport from one metal to the other. The author arrives at the result that the whole of the e.m.f. of a thermo-element has its seat in the temperature fall, so that such e.m.f.'s as the above must be absent. The latter part of the paper deals with the e.m.f.'s in dilute solutions. A. W.

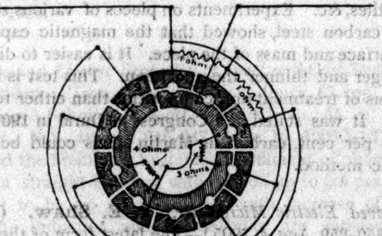
1773. *Sensitiveness of d'Arsonval Galvanometers.* **P. Pagnini.** (Elettricista, Rome, 4. pp. 210–214, July 15, 1905.)—The author refers to the three methods of increasing the sensitiveness of the d'Arsonval galvanometer: (i.) by decreasing the controlling force; (ii.) increasing the number of turns of the coil; and (iii.) by increasing the permanent magnetic field. Method (iii.) is the one chiefly described. It is found that for fields at which great sensitiveness is obtained, the magnetic properties of the suspended system become important and produce considerable disturbance [see Abstract No. 2686 (1904)]. To get over this difficulty, the system must be as free as possible from magnetic impurities, and the pole-pieces must be designed to give as nearly as possible a uniform field. Determinations of the period and sensitiveness of 19 galvanometers are given. S. G. S.

1774. *Wireless Telephony and Method of Determining Dielectric Constant.* **Kalischer.** (Elektrotechn. Zeitschr. 26. pp. 680–681, July 20, 1905.)—In the experiments recently described by Mosler [see Abstract No. 965B (1905)] the microphone was placed in the primary of an induction coil, one of whose secondary terminals was in connection with a spiral of wire, while the other was earthed. At the receiving station one of the receiver terminals was in connection with earth, the other being free. The action was attributed by Mosler to currents along the earth's surface. While not questioning the correctness of this explanation in the particular case considered, the author states that experiments carried out by himself show that when using an induction coil in the ordinary way the sound of the interrupter could be heard in a telephone receiver even when the secondary had no earth connection, provided the secondary terminals were not perfectly symmetrical, in which latter case the sound entirely ceased. The attachment of a piece of tin-foil to one of the terminals was sufficient, by destroying the symmetry, to cause the sounds to reappear. This suggests a method of determining dielectric constants, which consists in attaching to one terminal of the secondary the condenser whose dielectric is to be investigated, and to the other an air condenser of variable capacity. The author is making arrangements to test the method in practice. A. H.

1775. *The Electrolytic Detector.* **G. Ferrié.** (Comptes Rendus, 141. pp. 315–316, July 31, 1905. Écl. Électr. 44. p. 400, Sept. 9, 1905.)—The author points out that he showed in 1900 (Congrès internat. d'Elect., C.R., p. 289) that an imperfect contact formed of a minute metallic point and an electrolyte acts as an electric-wave detector. He apparently considers the detectors of Schloemilch and de Forest as practical applications of this idea. Explanations are given of the nature of the effect. Without external p.d. a ballistic galvanometer shows a current flowing from the Pt point, when waves arrive. With external p.d. the current is in the opposite direction and the sensitiveness is much greater, as has previously been shown by Schloemilch, de Forest, and others. **E. Merritt** (Elect. World and Engineer, 46. p. 185, July 29, 1905.)—Merritt points out that Pupin had previously published (Amer. Phys. Soc., Bull. 1. p. 21, 1899) an account of the use of the asymmetric cell as a detector. [See also Walter, Abstract No. 840 (1905).] L. H. W.

1776. *Nugues' New Construction for Dial Bridges.* **M. Aliamet.** (Électricien, 29. pp. 886–888, June 24, 1905.)—In this paper a method is given by means of which the number of coils necessary for one section of a dial resistance box, or any box of that type, can be reduced from nine to four for each significant figure indicated on the box. This method is clear from the accompanying Fig. The paper concludes with a description of an arrangement described some time since by Feussner, in which five coils only are required, but which does not permit of the above symmetrical arrangement.

D. K. M.



1777. *Direct-reading Resistance Thermometers. Composite Thermo-couples.* **A. Campbell.** (Phys. Soc., Proc. 19. pp. 555–565; Discussion, pp. 565–567, July, 1905. Phil. Mag. 9. pp. 713–722, May, 1905.)—Describes methods of modifying the bridge arrangement used in platinum thermometry so as to make it direct-reading. Reduction to the normal scale can be avoided, to a considerable degree of accuracy, by introducing a shunt across the terminals of the variable arms of the bridge. The value of this shunt can be calculated approximately, and the best resistance can then be found experimentally for any given platinum thermometer. The calculation in this and in the accurate method depends upon a knowledge of the constants of Callendar's parabolic formula as applied to the thermometer in question. With the values of such constants found in certain metals, as for instance iron, a similar direct-reading arrangement can be obtained by placing the shunt across the terminals of the thermometer itself, and if a part of this shunt-wire be allowed to vary in temperature with the thermometer itself, still better results are attained. A strictly accurate means of obtaining direct readings of temperature from platinum thermometers is then described; the portion of the bridge upon which the moving contact bears is given in the shape of a closed loop; values for the various resistances can then be calculated to give direct readings with a platinum thermometer of known constants. An application of a similar principle to thermo-couples is also described, the introduction of a wire of a third metal, of calculated resistance, between the members of the main couple at the hot junction being proposed in order to reduce the relation between thermo-electric voltage and temperature to a straight-line law.

W. Ros.

1778. *Electromagnetic Balance.* **de Kryloff.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 425–440, June 30, 1905.)—A magnetic balance of Hughes' type has been in use at the Imperial Arms Factory at Toula for testing, *e.g.*, the temper of certain parts of guns. A modified form was devised in which the permanent compensating magnet is replaced by an electromagnet, thus evading the use of a galvanometer and rheostat. Solenoids of several forms are used, suitable for taking the different pieces to be tested—barrels, projectiles, &c. Experiments on pieces of various shapes, made from a 0·4 per cent. carbon steel, showed that the magnetic capacity was proportional to the surface and mass of the piece. It is easier to differentiate grades of steel the longer and thinner the specimen. This test is much more sensitive to variations of treatment and composition than either tensile or hardness (Brinell) tests. It was stated at a Congress at Oural in 1902 that differences of about 0·025 per cent. carbon in Martin steels could be detected by the electromagnetic method.

F. R.

1779. *Improved Electric Micrometer.* **P. E. Shaw.** (Roy. Soc., Proc. Ser. A. 76. pp. 350–359, Aug. 4, 1905.)—The latest form of the micrometer [see Abstract No. 1241 (1903)] is described. Calibration is effected by means of Newton's rings, using sodium light. The method employed in the instrument is applicable to various measurements, *e.g.*, telephone diaphragm movements, and hence the amplitude of the least audible sound [see Abstract No. 1761 (1905)]; the distance of discharge of two surfaces maintained at different electrical potential, &c. A comparison is given with other micrometers. The practical sensitiveness (*i.e.*, the smallest distance which can be accurately read) for the different micrometers is as follows: Electric micrometer, 4×10^{-8} cm.; optical lever, $2{\cdot}3 \times 10^{-7}$ cm.; interference methods, 1×10^{-6} cm.; microscope, 2×10^{-5} cm. The paper discusses to what degree the different forms satisfy the requirements desirable in a micrometer.

A. W.

ALTERNATING CURRENTS AND MAGNETISM.

1780. *Properties of Pyrrhotine in the Magnetic Plane.* **P. Weiss.** (Comptes Rendus, 140. pp. 1332–1334, May 15, 1905.)—It having been shown previously that pyrrhotine is only magnetisable in certain planes [see Abstract No. 525 (1900)], a curve is obtained which exhibits the component magnetisation perpendicular to a constant field of about 4,000 c.g.s., which varies in azimuth in the magnetic plane mentioned. The curve has three maxima and three minima, the change from a minimum to the succeeding maximum being very abrupt. The curve repeats itself after 180°. The behaviour of the mineral is explained by considering how the magnetisation of an elliptical plate of soft iron would vary under similar conditions, and it is concluded that the crystal consists of three elements of which one or another may preponderate, the preponderance of any one element being accompanied by a corresponding strong maximum in the magnetisation curve.

G. E. A.

1781. *Magnetic Properties of the Simple Element of Pyrrhotine.* **P. Weiss.** (Comptes Rendus, 140. pp. 1532–1535, June 5; and pp. 1587–1589, June 13, 1905.)—A crystal of pyrrhotine is formed by the association of three elementary crystals placed at angles of 120°. The element has a direction of "easy" and another of "difficult" magnetisation; and the effects described [see preceding Abstract] may be explained by supposing that the substance annuls, by a demagnetising effect due to its structure, a component of the field in the direction of difficult magnetisation, the remaining component being parallel to the magnetisation. The hypothesis is also made that saturation is reached in very small fields, in the direction of easy magnetisation. The susceptibility in a direction normal to the magnetic plane is measured, the value found being 314×10^{-6}, from which the atomic susceptibility 0·0098 is deduced. This value closely approaches that of iron in paramagnetic substances. The three papers are fully dealt with and amplified in Journ. de Physique, 4. pp. 469–508, July, 1905. G. E. A.

1782. *Magnetic and Electric Properties of Sheet and Cast Steel.* **G. Dillner** and **A. F. Enström.** (Iron and Steel Inst., Journ. 67. pp. 474–480, 1905. Abstract of Carnegie Scholars' Report. Electrician, 55. p. 172, May 19, 1905. Elect. Rev., N.Y. 46. pp. 946–947, June 10, 1905.)—The increase of coercive force and the Steinmetz hysteresis coefficient of sheet samples were found to follow a straight-line law with carbon up to 0·5 per cent. In cast steel there ought to be no inconvenience with increase of carbon up to 0·3 per cent.—the induction and permeability are satisfactory, and the electrical resistance higher with increased carbon. Increase of Si was accompanied by noticeable increase of coercive force and hysteresis loss, without much affecting the maximum induction. The disadvantage far outweighs the gain in electrical resistance, so that Si should be kept low in sheet material. In cast steel, however, the results of similar increment of Si were very satisfactory; but with about 2 per cent. Si the risk of piped castings arises. Al has been found to reduce the hysteresis loss, increase the electrical resistance, and reduce the max. induction and the permeability for ordinary saturation values, thus generally improving sheet material, but not being of value in cast steel. Cast steel containing both Al and Si, however, showed low hysteresis loss and good permeability and max. induction. The authors found good agreement between their figures for electrical resistance and those given by Benedicks' recent formula. Annealing improved the magnetic properties in general of the cast materials, and especially the hysteresis loss. Sheets were not annealed, but the coercive force and hysteresis loss are about 10 per cent. better at the edges than at the centre. A comparison of the suitability for electromagnetic purposes of the several sheet steels used, according to process of manufacture, places them in the following order: Lancashire iron, basic open-hearth, acid open-hearth, Bessemer. In steel with high Al content, the carbon segregates at the edges of grains in a sorbitic state. F. R.

1783. *Area of Local Magnetic Disturbance in East Loch Roag, Lewes, Hebrides.* **A. M. Field.** (Roy. Soc., Proc. Ser. A. 76. pp. 181–184, June 28, 1905.)—A deflection of the compass needle having been observed in October, 1902, eastward of Little Bernera Island, at the entrance of Loch Roag, a preliminary survey, and afterwards, in June, 1903, a more complete examination, were made by H.M.S. *Research*, under the author, with the aid of a heeling error instrument and a Kelvin deflector. Variation, vertical force, and horizontal force were determined—under great difficulties, owing to the heavy swell—at 78 stations, the ship being tautly moored at each. The maximum disturbance from the normal was found to be for vertical force 0·056 c.g.s. unit, the north-seeking end of the needle being repelled in an upward direction from the "valley line," which lies nearly in the magnetic meridian, and for variation 11½°. The normal vertical force, according to Thorpe—there is a Rücker-Thorpe station on Great Bernera Island—is 0·451, the normal horizontal force 0·15507 c.g.s. unit, and the normal variation 21° 30′ W. The agreement of the "valley line" determinations by observations for variation and vertical force is noticeable. H. B.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

1784. *Relation between Electrode-surface and Electrical Resistance of the Human Body.* **S. Leduc.** (Archives d'Él. Médicale, 13. pp. 457–462, June 25, 1905.)—It has previously been shown that the skin saturated with an ion at a given voltage has a constant resistance [see Abstract No. 1192 (1904)]. Measurements are now described, made under these conditions. To obtain a straight-line relation between current and extent of contact surface of electrodes it is necessary to consider the sum of the peripheries of the two electrodes, and not the area. Even in such a case the curve does not pass through the zero of the line of abscissæ, so that the conductivity varies as the variable Kp + a constant, where p is the periphery. This law is asserted by the author to hold also in the case of electrolytes, and even for metallic conductors. L. H. W.

REFERENCES.

1785. *Magnetic Effect of Moving Charges.* **H. Pender.** (Internat. Elect. Congress, Trans. 1. pp. 443–457, 1904.)

1786. *Electrostriction.* **L. T. More.** (Internat. Elect. Congress, Trans. 1. pp. 423–437, 1904.)—[See also Abstract No. 1148 (1904).]

1787. *Photograph of Lightning Exhibiting Incandescence of the Air.* **E. Touchet.** (Comptes Rendus, 140. pp. 1031–1033, April 10, 1905.)—A photograph of a flash taken on the evening of April 12, 1904, exhibits a ribbon-like structure which is attributed by the writer to the residual glow of the air after the flash has passed. G. E. A.

1788. *Electric Dissipation during the Annular Solar Eclipse of March* 17, 1904. **W. van Bemmelen.** (Phys. Zeitschr. 6. pp. 235–236, April 15, 1905.)—Elster observed an increase in the dissipation in Algiers, 1900, Fige a decrease in Sumatra, 1901, after the shadow cone had passed the station. The author made observations with an Elster-Geitel apparatus (from Günther and Tegetmeyer) at Sabang, Sumatra, where the eclipse was annular for 8 min. There was no distinct effect, and since 86 per cent. of the sun disc was obscured, the author does not think that an effect would have been observed if the eclipse had been total. H. B.

1789. *Wireless Telegraphy.* **N. Pizzarello.** (Accad. Sci. Torino, Atti, 40. 9. pp. 419–420, 1904–1905.)—By allowing sparks of less than 1 mm. length to pass between one pole of a Wimshurst and an earthed sphere, an extremely regular effect on a coherer at distances up to 50 m. was observed. S. G. S.

1790. *Discharge of Negative Ions from Glowing Metallic Oxides.* **A. Wehnelt.** (Phil. Mag. 10. pp. 80–90, July, 1905.)—An account of the discharge of negative electricity by metallic oxides, among which were the oxides composing Nernst burners. The paper is well illustrated by tables of observations, also by diagrams. It is divided into four parts, treating the following topics: (1) Emission of negative ions at atmospheric pressure; (2) the same at low pressures; (3) glowing metallic oxides as kathodes in discharge tubes; (4) applications of these glowing oxides in construction of discharge tubes. [See also Abstract No. 2681 (1904).] E. H. B.

1791. *Electric Wave Propagation.* **W. S. Franklin.** (Frank. Inst., Journ. 160. pp. 51–70, July, 1905.)—A simple explanation of electric wave propagation, based on Maxwell's cellular theory of the ether. [See Abstract No. 419B (1905).] A. H.

1792. *Temperature Coefficient of the Resistance of Tantalum.* **F. Streintz.** (Zeitschr. Elektrochem. 11. pp. 273–274, May 5, 1905.)—It is pointed out that with rising atomic weights the temperature coefficient for resistance also increases. The atomic weight of tantalum is 183, and the temperature coefficient being 0·3 per cent. between 0°–100° C. the law is followed by this metal. Some remarks are also made on the atomic heat of tantalum. W. W. H. G.

1793. *Characteristics of Holtz Machine.* **H. Dingle** and **J. S. Knowlson.** (Elect. World and Engineer, 45. p. 1172, June 24, 1905.)—The authors give a series of curves connecting the p.d. with the current of a Holtz machine for various speeds. From these curves it appears that the Holtz machine is capable of delivering an approximately constant current over a wide range of voltage. A. H.

1794. *Divergence of Electroscope Leaves by Illumination.* **S. Guggenheimer** and **A. Korn.** (Phys. Zeitschr. 6. pp. 412–414, July 1, 1905.)—Shortly after the discovery of this effect by the authors it was suggested by F. Paschen [Abstract No. 1181 (1904)] that the phenomenon was a radiometer effect. Further experiments are now adduced which prevent the authors from accepting the view that a radiometer effect is the only or the essential source of the phenomenon. [See also Abstract No. 1180 (1904).] E. H. B.

1795. *Thermo-electric Investigations.* **A. Palme.** (Zeitschr. Elektrotechn., Wien, 23. pp. 413–414, July 2, 1905.)—The paper contains an account of some thermo-electric investigations, the results of which are embodied in a series of curves. The investigations were undertaken mainly with the object of determining combinations suitable for purposes of pyrometry. Among those giving an approximately straight-line law for the relation connecting e.m.f. and temperature were found to be the following: platinum-carbon, silver-copper, German-silver-iron, constantan-iron. A. H.

1796. *Electrometer for the Investigation of Induced Radio-activity.* **H. Gerdien.** (Phys. Zeitschr. 6. pp. 433–436, July 15, 1905. Geophysikal. Inst., Göttingen, June, 1905.)—The capacity must be as small as possible. The precautions to be taken so as not to neglect the easily absorbed α-rays are dealt with. The instrument described is shown to fulfil the required conditions; the loss of potential is only about 0·8 volt per hour. Results are given of a comparison of the instrument with the apparatus of Elster and Geitel. A. W.

1797. *Extension of the Graphical Methods used in Alternating-current Theory.* **Swyngedauw.** (Soc. Int. Élect., Bull. 5. pp. 445–468, June, 1905.)—Starting with the equation $e = Ri + l\,di/dt$, it is shown that, whatever the shape of the applied wave, we have $V^2 = (R^2 + a^2 l^2 w^2)A^2$, where a is a quantity whose minimum value is unity. If ϕ be the phase-difference between the currents $f(t)$ and $f(t + \Delta t)$, a proof is given that $a = \Delta\phi/\Delta t$. In an appendix numerical examples are given. A. R.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1798. *Isomorphism and Thermal Properties of the Feldspars.* **A. L. Day** and **E. T. Allen.** (Amer. Journ. Sci. 19. pp. 93–142, Feb., 1905.)—The minerals used were anorthite, $CaAl_2Si_2O_8$, and albite, $NaAlSi_3O_8$ (artificially prepared), and the determinations of the melting-points, densities, and optical properties of mixed crystals of the minerals served to establish their isomorphism. Anorthite melts sharply at 1,532° to a comparatively limpid liquid, but towards the albite end of the series the viscosity of the liquid became very great, and it was impossible accurately to determine the melting- or freezing-point. The melting-point of albite is probably below 1,200°, but instead of proceeding sharply, the change is marked only by the penetration into the crystalline mass of areas of amorphous material which are clearly seen when sections are examined with a polarising microscope. Powdered crystalline felspars do not readily sinter below the melting-point. The powdered glasses, on the other hand, sinter much below the melting-point of the crystals. Anorthite glass crystallised readily when heated to 490–500°, but the more viscid melts gave glasses which could only be made to crystallise with extreme difficulty. T. M. L.

1799. *Viscosity and Electrical Conductivity of Aqueous Salt Solutions.* **E. Grüneisen.** (Phys. Techn. Reichsanstalt, Wiss. Abh. 4. pp. 239–266, 1905.)—The solutions studied were for the most part identical with those whose conductivity had been accurately measured by Kohlrausch and his colleagues. I. Exceptional care was taken with the viscosity measurements, the time of flow being determined with a probable error in the mean of a series of observations of only 1 to 2 per thousand in the case of the more dilute solutions; values for η_{18} are given for 76 different solutions; in the case of one-third of these the linear and quadratic temperature coefficients are given. Whilst in a few cases (KCl, KNO_3, KI) the viscosity of a salt solution may be less than that of water, in most cases the viscosity is increased, the highest value recorded being 3·272 for 3-N $LiIO_3$ [50 per cent. NaOH, however, gives $\eta_{18} = 70$ (approx.)]. The temperature coefficients are of the same order as the coefficients of electrical conductivity. II. Striking results were obtained on calculating the change of viscosity per equivalent of salt $(\eta - 1)/m$. In the case of cane-sugar this function decreases with the concentration, reaching a steady minimum value in dilute solutions; this may be regarded as the normal behaviour of a non-electrolyte. In the case of all the salts examined, however, the function $(\eta - 1)/m$ after decreasing to a minimum value (usually at about 0·2N, but in exceptional cases at concentrations up to normal) showed a rapid increase as the dilution was increased; this behaviour was observed even with solutions less viscous than water. The measurements became unreliable below about N/20, but it is clear that *the ionisation of the solute always increases the viscosity of a solution.* The relationship between viscosity and concentration may be expressed in the case of electrolytes by the formula $(\eta - 1)/m = Ai + B(1 - i) + Cm$, where i = coefficient of ionisation, m = concentration, and in the case of non-electrolytes by—$(\eta - 1)/m = B + Cm$. III. *Viscosity as an additive property.*—At infinite dilution the viscosity of a salt solution would probably be an additive function of the component radicals or ions. The viscosity decreases in the series $\frac{1}{2}$Mg, $\frac{1}{2}$Ca, Li, $\frac{1}{2}$Pb, Na, K, and $\frac{1}{2}C_2O_4$, $\frac{1}{2}CrO_4$, $\frac{1}{2}SO_4$, IO_3, Cl, NO_3, I. IV. *Relationship between viscosity and conductivity.*—(1) The temperature coefficients of viscosity are related to the viscosity coefficients themselves, and a regular curve is obtained when $1/\eta \, . \, d\eta/dt$ and η are plotted against one another. (2) Except in the case of the nitrates and iodates there is a linear relationship between the viscosity temperature coefficients $1/\eta \, . \, d\eta/dt$ for normal solutions, and the electrical temperature coefficients $1/\Lambda \, . \, d\Lambda/dt$ for infinite dilution. (3) In the case of (*a*) the monovalent and (*b*) the divalent ions, there appears to be a linear relationship between the reciprocal of the mobility of the ion and the change which it produces in the viscosity of the solution. T. M. L.

1800. *Tensile Strength of Copper-Tin Alloys.* **E. S. Shepherd** and **G. B. Upton.** (Journ. Phys. Chem. 9. pp. 441–476, June, 1905.)—The authors studied the effects of heat treatment on the tensile strength of cast copper-tin alloys containing over 70 per cent. Cu. The complete equilibrium diagram for bronzes, which has been redetermined by Shepherd and Blough, will be given later. The maximum load for bronzes is the same as the breaking load. Tin-rich α-crystals are stronger than those low in tin; bronzes containing no α-crystals are very weak. The strength of pure α-bronzes is little affected by heat treatment. Prolonged annealing tends to coarsen the structure, decrease strength, and increase ductility. The maximum strength occurs with 78 to 81 per cent. Cu, being over 60,000 lbs. per sq. in. after heating the alloys to 540° for one week, or to low red, and quenching; elongation is about 1·5 per cent., and the structure is α- and β-crystals. Maximum elongation (about 39 per cent. as against 10 per cent. as cast) is attained in bronzes containing 88 to 90 per cent. Cu (breaking strength 45,000 lbs. per sq. in., with same treatment). Elongation of alloys as cast diminishes with decreasing Cu content. Alloys containing 74 to 87 per cent. Cu are much stronger if annealed above the inversion temperature, 510°. Of bronzes annealed below 510°, the strongest consist of mixtures of α- and δ-crystals. F. R.

1801. *Effects of Liquid-air Temperature on Iron and its Alloys.* **R. A. Hadfield.** (Iron and Steel Inst., Journ. 67. pp. 147–219; Discussion and correspondence, pp. 220–255, 1905.)—The full account of the research dealt with in Abstract No. 371 (1905). A diagram of the relation between electric resistance and temperature for Cu, Fe, Ni, and Al, shows that there is a steady increase of resistance in each case from liquid-air temperature to + 200° C. The average size of grains of Swedish charcoal iron, cooled to − 182° C. and polished after returning to atmospheric temperature, was slightly greater than that of a normal sample of the same iron; but the evidence was insufficient to prove that a change in structure had been brought about by the treatment. A polished section, photographed whilst immersed in liquid air, showed no difference of structure whatever from that at ordinary temperature. A few other photomicrographs are added—nickel, electrolytic iron, &c. F. R.

1802. *Structure and Critical Ranges of High-speed Tool Steels.* **H. C. H. Carpenter.** (Iron and Steel Inst., Journ. 67. pp. 433–473, 1905. Carnegie Research Scholar's Report.)—Experiments were first made on the effect of chromium, tungsten, and molybdenum separately; in the case of the iron chromium carbon alloy it was found that the temperature from which the cooling-curve is taken is almost without influence on the critical point, and that increase of Cr tends to raise the critical point. The iron-carbon-tungsten and iron-carbon-molybdenum alloys differ in showing a marked dependence of the extent and character of their critical ranges upon the temperature from which cooling was begun; the whole range is enormously widened, the lower limit being progressively lowered. This holds true of ordinary rates of cooling, but not for excessively slow cooling. The high-speed tool steels closely resemble these alloys in this respect; in use they undergo a very great widening and lowering, if not a complete suppression of the critical ranges. The tungsten steels require to be heated to 1,200° C. for this purpose, while with molybdenum steels 1,100° is sufficient. The action of either of these elements consists in hindering, and, under suitably chosen conditions, in altogether preventing changes in iron-carbon alloys which would result in softening the material. The metallographic examination shows that in spite of the presence of up to 18 per cent. of special elements, iron and carbon remain all-important in determining the types of structure; practically all the structures found might be obtained from iron-carbon steels by suitable heat treatment. W. Ros.

1803. *Silver-Aluminium Alloys.* **G. I. Petrenko.** (Zeitschr. Anorg. Chem. 46. 1. pp. 49–59, July 31, 1905. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—The alloys could only be prepared by melting the aluminium in a crucible and introducing the silver bit by bit. The cooling-curves and microscopic data, described and discussed in detail, are regarded as establishing the existence of eleven distinct areas in the equilibrium diagram and the existence of two definite compounds, viz., $AlAg_3$ and $AlAg_2$, both of which exist in two modifications, and give rise to a series of mixed crystals. In the alloys containing from 4 to 7·72 per cent. Al, mixed crystals of Ag and Al first separate out until the Al in the remaining fluid has risen to the point corresponding to the compound $AlAg_3$, when the remainder crystallises as homogeneous $AlAg_3$, no eutectic being formed. W. Ros.

1804. *Effects of Stress-reversal in Steel.* **J. C. Gardner.** (Iron and Steel Inst., Journ. 67. pp. 481–483, 1905. Abstract of Carnegie Scholar's Report.)—Specimens of steel were quenched from temperatures 50° apart and ranging from 550° to 900° C. The quenched specimens were tested under reversals of stress in a machine similar to Woehler's. The maximum hardness was found in metal quenched from 850°; at this temperature the structure consists entirely of martensite; increase of the temperature of quenching does not further harden the steel but increases physical defects; the mechanical hardness is thus due to martensite. The size of the martensite grains was found to increase with higher temperatures, longer heating producing more definite, but not larger grains. A rising temperature was found to produce larger grains as well as holding the specimen at the final temperature, from which the author concludes that the grains of martensite are due to the effects of actual heating above the critical temperature Ar_3. W. Ros.

1805. *Troostite, and Heat Treatment and Fatigue of Steel.* **F. Rogers.** (Iron and Steel Inst., Journ. 67. pp. 484–494, 1905. Abstract of Carnegie Scholar's Report.)—I. Evidence is cited in favour of the view that troostite is a transition form between martensite and sorbite, as opposed to the view of

Boynton that it is β-iron. The chief point of this evidence is the quantity of troostite sometimes found in steels containing as much as 0·9 per cent. C; if such troostite be a form of iron then the adjacent martensite would require to be supersaturated to an improbable degree. The author regards troostite as an intimate mixture of ferrite or cementite with a solid solution of the two. II. Three grades of steel were experimented with, containing 0·27, 0·14, and 0·32 per cent. C respectively, annealed at various temperatures. Annealing produces a general lowering of ultimate strength and elastic limit, with reduced endurance of fatigue; with actual overheating the endurance falls very low. Quenching produces a great increase in endurance. To test the effect of reheating after fatigue, test-pieces were first fatigued under known conditions for a portion of their probable life and were then reheated; the results, though very irregular, gave a perfectly clear indication that when fatigue had gone beyond a certain point mere reheating could not remove its effects. The fracture of such specimens showed heat-tint marks. This slight oxidation, the author considers, would prevent the reunion of the fissured surfaces even when strongly heated. Heat-tinting as a means of investigating the state of cracks at any desired stage of the life of a piece of metal exposed to alternating stresses is suggested. The microscopic effects of fatigue in steels were found to be similar to those found by Ewing and Humfrey in Swedish iron, but the slip-bands developed were of two distinct types, one indicating normal and the other overheated samples. W. Ros.

1806. *Aluminium Steels.* **L. Guillet.** (Comptes Rendus, 141. pp. 35–36, July 3, 1905.)—The mechanical properties of steel are little affected by additions of Al up to 3 per cent.; greater quantities diminish elongation and contraction and increase brittleness; 7 per cent. Al alloys are extremely brittle. Up to at least 15 per cent., Al apparently dissolves in iron. The steels are pearlitic—they exhibit a compact variety of pearlite whose compactness increases, and quantity decreases, with increase of Al. When the Al content is high (10 to 15 per cent.), cementite has replaced the pearlite. Upon quenching pearlitic Al steels from above 850° C. a martensite is obtained which occupies strictly the place formerly held by pearlite, whence the author considers that Fe-Al solution will not dissolve carbon. The effect of quenching the cementitic alloys is greater the higher the quenching temperature—up to about 950° troostite results, but at 1,000° martensite is obtained. Graphite was not produced upon annealing these alloys. Cementation of a 50 per cent. Al steel occurred with extraordinary slowness; cementite was formed, but not pearlite. F. R.

1807. *Decomposition of Ammonia at High Temperatures.* **A. H. White** and **W. Melville.** (Amer. Chem. Soc., Journ. 27. pp. 373–386, April, 1905.)—The results of the experiments show that the temperature of initial decomposition is about 450°. The percentage decomposition of ammonia gas passing through a hot tube is not affected by dilution by an inert gas such as H or N, provided the time which each ammonia molecule remains in the hot tube is not changed. This confirms the view that the decomposition is irreversible and that there is no recombination. Gases such as CO and water vapour increase the rate of decomposition. The decomposition may be 50 times as great when the gas is in contact with porcelain as when it is in contact to the same extent with glass. It is concluded that in the destructive distillation of coal, the decomposition of ammonia may be prevented by keeping the temperature low and by lessening the time during which the red-hot gases remain in contact with rough substances like coke or the fire-clay retort. The introduction of blue water-gas into the retorts, as in the Lewes process, should lessen the ammonia decomposition owing to the rapid removal of the gases. [See also Abstract No. 2928 (1904).] T. H. P.

1808. *Dissociation of Water Vapour.* **W. Nernst** and **H. v. Wartenberg.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 1. pp. 35–45, 1905.)—The dissociation-ratio was experimentally found to be 0·000078 at 1,124° C., 0·000189 at 1,207°, 0·00034 at 1,288°, and 0·0018 at 1,531°, but the range giving reliable results extends only from 1,100° to 1,200°. These numbers agree very well with the theoretically deduced formula—

$$\log [x^3/(2+x)(1-x)^2] = A - BT^{-1} - CT + D \log T,$$

with the values $B = 25{,}030$, $C = 0{\cdot}00055$, $D = 2{\cdot}65$ deduced from Langen's determinations of the molecular heats of the gases in question. R. E. B.

1809. *Dissociation of CO_2.* **W. Nernst** and **H. v. Wartenberg.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 1. pp. 64–74, 1905.)—The dissociation-ratio was found to be 0·00004 at 1,027° C., between 0·0001 and 0·0003 at 1,127°, and 0·00029 at 1,205°, which numbers agree very well with the theoretical formula given in the preceding Abstract with the values $B = 29{,}560$, $C = 0{\cdot}00074$, $D = 2{\cdot}97$ deduced from Langen's determination of the molecular heat of CO_2. R. E. B.

1810. *Chemical Transference of Metallic Potentials and the Chemical Solution Tension of Metals.* **F. Fischer.** (Zeitschr. Phys. Chem. 52. pp. 55–88, June 9, 1905. I. Chem. Inst. d. Univ., Berlin, Nov., 1904.)—When a freshly prepared solution of $CuSO_4$, which always contains oxygen, is acidulated with H_2SO_4, two reactions will take place at the surface of contact between liquid and metal. Firstly, cupri-sulphate will be formed from metal, oxygen, and acid; secondly, the cupri-salt will dissolve the metal, when oxygen is excluded, under formation of cupro-sulphate according to $Cu^{\cdot\cdot} + Cu \rightleftarrows 2Cu^{\cdot}$. Both these reactions will proceed with infinite rapidity at the contact surface and equilibrium will soon result, that is to say, as much copper will be deposited as dissolved. But the ions will be distributed by diffusion and convection all through the solution. The cupro-salt will be oxidised as long as there is any oxygen present in the solution, until the concentration ratio of cupro- to cupri-salt will everywhere be the same as at the surface of contact. When the solution further contains a piece of platinum there will be more oxidation, because the platinum will have absorbed oxygen from the atmosphere. Finally, the same equilibrium will result throughout the solution, and copper will be dissolved and precipitated on the platinum as on the copper. During this period the p.d. between the platinum and the copper will diminish more and more, down to zero. These arguments the author confirms by experimenting with two electrodes, one of bright platinum and one of platinum previously coppered in Oettel's solution. The change in the potential is quite gradual, proving that it is not due to any copper particles adhering to the platinum. The potential of the copper is, by means of the cupro-sulphate, so to say, transferred to the platinum. Similar experiments are made with Hg and Pt; they are less successful with Ag and Pt, and in the case of Zn and Pt, the potential difference is reduced only to the value metal/metal salt solution/hydrogen. The author's views are further confirmed by a study of the copper chlorides and particularly of the temperature influence in these phenomena. The platinum plays successively the part of oxygen electrode, platinum electrode, alloy electrode, and copper electrode. As regards the theory, the author points out that, while Nernst assumes an electrolytic solution tension because the metallic molecules which tend to dissolve are charged electro-positively, there is here evidence of a chemical solution tension of the electrically-neutral molecules (according to $Cu + Cu^{\cdot\cdot} \rightleftharpoons 2Cu^{\cdot}$), which is balanced by a tension to form copper, *i.e.*, by a deposition tension. H. B.

REFERENCES.

1811. *Atomic Weight of Tellurium.* **G. Gallo.** (Accad. Lincei, Atti, 14. pp. 23–28, Jan. 8, and pp. 104–109, Jan. 22, 1905.)—Employing a silver voltameter, the author has determined the electrochemical equivalent, and thence the atomic weight of tellurium, the electrolyte being prepared by dissolving TeO_2 in HF, evaporating to dryness several times and redissolving in water with a few drops of HF. The mean of twelve determinations gives an atomic weight of 127·61, taking that of silver as 107·93. A preliminary determination of the atomic weight of copper, to test the voltameter, gave 63·58. W. H. Si.

1812. *Revision of Atomic Weights of Sodium and Chlorine.* **T. W. Richards** and **R. C. Wells.** (Amer. Chem. Soc., Journ. 27. pp. 459–529, May, 1905.)—The investigations made by the authors consist of a very careful quantitative study of the three ratios, AgCl : NaCl, Ag : NaCl, and Ag : AgCl. Taking the atomic weight of silver to be 107·920, that of sodium is found to be 23·006, and that of chlorine 35·470. T. H. P.

1813. *Reciprocal Replacement of Metals in Aqueous Solutions.* **G. McP. Smith.** (Amer. Chem. Soc., Journ. 27. pp. 540–551, May, 1905.)—The author shows that the metals in the following pairs are reciprocally replaceable in aqueous solution, the first metal in each pair being under ordinary circumstances more readily replaceable by the second than the second by the first: K, Na; K, Ba; Na, Ba; Zn, Cu; Cd, Cu; Fe, Hg; Fe, Ag; Hg, Ag; Hg, Pt; Hg, Au; Ag, Au. T. H. P.

1814. *Influence of Hydroxyl and Alkoxyl Groups on Velocity of Saponification.* I. **A. Findlay** and **W. E. S. Turner.** (Chem. Soc., Journ. 87. pp. 747–761, May, 1905.)—The introduction of a hydroxyl group into ethyl phenylacetate, resulting in the formation of ethyl mandelate, causes a very considerable increase in the velocity of hydrolysis of the ester by alkalies. Replacement of the hydrogen of the hydroxyl by alkyl groups causes a diminution in the velocity of hydrolysis proportional to the mass of the alkyl group. T. H. P.

1815. *Polymorphic Transformations by Mechanical Actions.* **F. Wallerant.** (Comptes Rendus, 140. pp. 1268–1270, May 8, 1905.)—A crystalline mixture of 1 part of thallium nitrate with 7 of ammonium nitrate is stable at the ordinary temperature under two forms, one of which is quasi-quadratic and positive and forms twins, while the second is quasi-ternary, negative and strongly bi-refringent, and does not twin. If the fusion crystals (first type) are slightly compressed with the point of a needle they are transformed into the second kind; by passing the needle again across the latter, they are reconverted into the first type. This is the first known example of polymorphic transformation by mechanical means. [See also Abstract No. 892 (1904).] T. H. P.

1816. *Chemical Combinations.* **Berthelot.** (Comptes Rendus, 140. pp. 1153–1159, May 1, 1905.)—The researches on the influence of a high temperature followed by sudden cooling have been continued [see Abstract No. 1101 (1905)]. An earthenware or porcelain tube is heated by a band of platinum wound helically round the tube. Inside this is a quartz tube sealed by the blow-pipe, surrounded by thin platinum-foil so as to protect it from contact with the outer tube. The gas in this tube is reduced to about 0·5 atmos. Experiments were made with N and H in the proportion of 1 to 3 by volume, heated to 1,300° for an hour, and then suddenly cooled. No trace of NH_3 formed. The ratio of N to H was now about 1 to 2. Further experiments showed that the decomposition of NH_3 commenced at red heat and that the transpiration of H at a pressure of 0·7 mm. was not sensible below 800°.
W. W. H. G.

1817. *Increase in Rotatory Power of Aliphatic Molecules on becoming Cyclic Compounds.* **A. Haller** and **M. Desfontaines.** (Comptes Rendus, 140. pp. 1205–1208, May 8, 1905.)—A generalisation of the results already obtained with ethyl β-methyladipic acid [see Abstract No. 1529 (1904)]. The authors come to the conclusion that a considerable difference exists between the rotatory powers of the methyladipic esters and the condensed cyclic esters, the latter being about thirty times the more active.
W. H. Si.

1818. *Fusibility of Mixtures formed by Antimony Sulphide with Cuprous Sulphide and Mercuric Sulphide.* **H. Pélabon.** (Comptes Rendus, 140. pp. 1389–1392, May 22, 1905.)—The author's measurements give for the cryoscopic constant of antimony sulphide the numbers 797 and 788, which agree well with the value (790) given by Guinchant and Chrétien [see Abstract No. 1983 (1904)].
T. H. P.

1819. *Autocatalysis and Transformation of γ-Hydroxy-acids as Ionic Reactions.* **A. W. Visser.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 770–780, May 11, 1905. Proc. 7. pp. 760–769, May 25, 1905.)—It is shown that the spontaneous transformations of solutions of γ-hydroxy-acids into their lactones which have previously been regarded as autocatalytic changes may be considered as ionic reactions, and hence come within the scope of the laws of mass action.
T. H. P.

1820. *Properties of Anhydrous Chlorides of Rare Metals.* **C. Matignon.** (Comptes Rendus, 140. pp. 1339–1341, May 15, 1905.)—The author gives the density, melting-point, and heats of solution and formation of the chlorides of La, Pr, Nd, and Sm.
T. H. P.

1821. *Effect of Silver on the Chlorination and Bromination of Gold.* **H. O. Hofman** and **M. G. Magnuson.** (Amer. Inst. Mining Engineers, Bull. No. 2. pp. 421–433, March, 1905. Technology Quarterly, 18. pp. 73–85, March, 1905.)—A supersaturated solution of chlorine in water is found to act more strongly than one that is merely saturated, and a supersaturated solution can extract a satisfactory percentage of gold from a gold-silver alloy containing as much as 20 per cent. Ag. With decrease of chlorine below a certain amount and increase of silver above 10 per cent., the extraction of gold falls off quickly. Bromine is an efficient solvent for gold, especially in the presence of silver.
W. W. H. G.

1822. *Theory of the Velocity of Dissolution of Arsenic.* **E. Brunner.** (Zeitschr. Phys. Chem. 51. pp. 494–499, April 11, 1905.)—Bruner and Tolloczko have shown that the velocity of dissolution of arsenic is abnormal [see Abstract No. 443 (1904)]. This result can be explained by supposing that the arsenic dissolves in the form of anhydride As_2O_3, but becomes hydrated before it has diffused far enough from the surface of the solid to be affected by the stirring [see also Abstract No. 3297 (1904)].
T. M. L.

1823. *Solubility Studies.* **F. Hoffmann** and **K. Langbeck.** (Zeitschr. Phys. Chem. 51. pp. 385-434, April 11, 1905.)—Experiments were made to determine the influence of various substances, organic and inorganic, on the solubility in water of benzoic, salicylic, and *o*-nitrobenzoic acids. The addition of salts increased the solubility of benzoic acid, but in the case of *o*-salicylic acid a small preliminary increase of solubility was noticed, and in the case of *o*-nitrobenzoic acid the maximum was very marked. T. M. L.

1824. *Solubility of Phosphorus in Ether and Benzene.* **A. C. Christomanos.** (Zeitschr. Anorg. Chem. 45. 2. pp. 132-141, May 22, 1905. Universitätslaboratorium, Athen.)—The author gives solubility tables for phosphorus in ether and benzene. 100 gm. of ether dissolve 0·4335 gm. of phosphorus at 0° and 1·9984 gm. at 35°, while 100 gm. of benzene dissolve 1·513 gm. at 0° and 10·027 gm. at 81°. Results of refractometric measurements are also given. T. H. P.

1825. *Properties of Certain Cerium Salts.* **H. Wolff.** (Zeitschr. Anorg. Chem. 45. 2. pp. 89-115, May 22, 1905. Chem. Inst. der Univ., Bonn.)—The solubilities are given of ceric ammonium nitrate, cerous ammonium nitrate, cerous ammonium sulphate, and of cerous formate, acetate, propionate, butyrate, and *iso*-butyrate. T. H. P.

1826. *Conductivity of Colloidal Solutions.* **J. Duclaux.** (Comptes Rendus, 140. pp. 1468-1470, May 29, 1905.)—Conductivity measurements of colloidal solutions of ferric hydroxide show that the electric charge of 1 valency-gm. of the hydroxide is about 1/500 of that corresponding with a valency-gm. of an ion. This number is not fixed for any one colloid, but seems to assume any value above a certain minimum. Similar measurements with copper ferrocyanide give the number 1/800, and with arsenic sulphide 1/3500. [See also Abstracts Nos. 929 and 2416 (1904).] T. H. P.

1827. *Physical Properties of Propane.* **P. Lebeau.** (Comptes Rendus, 140. pp. 1454-1456, May 29, 1905.)—The following are the results obtained by the author: Boiling-point of propane, $-44{\cdot}5°$ at 757 mm. pressure; freezing-point, below $-195°$; critical temperature, 97·5°. The solubility of propane in alcohol, ether, chloroform, benzene, and essence of turpentine is given. T. H. P.

1828. *Heat of Formation of Sodium Hydride. Acidity of the Hydrogen Molecule.* **de Forcrand.** (Comptes Rendus, 140. pp. 990-992, April 10, 1905.)—Four measurements give the molecular heat of solution of sodium hydride as $+25{\cdot}80 \pm 1$ Cal., from which are deduced: H_2 (gas) + Na (solid) = NaH (solid) + H (gas) . . . + 16·60 Cal. and H_2 (solid) + Na (solid) = NaH (solid) + H (gas) . . . + 16·00 Cal. The value of the acidity of the molecule of solid hydrogen is hence + 16·00 Cal. The negative influence of one of the atoms of the molecule of hydrogen in diminishing the real acidity of the hydrogen atom is then dealt with. T. H. P.

1829. *Electrical Method for Combustion of Organic Compounds.* **H. N. Morse** and **L. S. Taylor.** (Amer. Chem. Journ. 33. pp. 591-603, June, 1905.)—The authors describe the arrangement and use of an electrical device for determining carbon and hydrogen in carbon compounds; it can also be applied in the case of compounds containing nitrogen, halogens, or sulphur. T. H. P.

1830. *Different Forms and Transformations of the Boundary Curves in the Case of Partial Miscibility of Two Liquids.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 660-672, April 5, 1905. Proc. 7. pp. 636-646, May 25, 1905.) F. G. D.

1831. *Course of the Spinodal Curves and of their Plait-points for all Temperatures in the Case of Mixtures of Normal Substances.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 685–696, April 5, 1905. Proc. 7. pp. 646–657, May 25, 1905.) F. G. D.

1832. *Shape of the Plait-point Curve for Mixtures of Normal Substances.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 14–29, June 7, 1905. Proc. 8. pp. 33–48, June 21, 1905.)—This paper, as well as the two preceding ones, deals with problems in graphical thermodynamics and does not admit of a short abstract. F. G. D.

1833. *Free Energy and Heat Capacity.* **J. M. Bell.** (Journ. Phys. Chem. 9. pp. 381–391, May, 1905.)—A criticism of the conclusions arrived at by Richards [see Abstract No. 673 (1903)] and by van't Hoff [Abstract No. 2230 (1904)] as to the nature of the relationships between change of heat capacity, change of free energy, and heat of reaction in an isothermal variation of state. None of these conclusions is justified, according to the author, by the experimental facts, and some of them contain implicit self-contradictions. The Helmholtz equation is and remains the most general statement of the relationship between heat of reaction and change of free energy. [See also Abstract No. 1432 (1905).] F. G. D.

1834. *Relation between Logarithmic Temperature-constant and Heat of Reaction.* **J. Plotnikow.** (Zeitschr. Elektrochem. 11. pp. 389–390, June 23, 1905. Phys. Chem. Inst., Leipzig, May, 1905.)—In continuation of his previous paper [Abstract No. 1488 (1905)] and in reply to the criticism of Auerbach [Ibid. pp. 296–297, May 19] the author maintains that $d \log K/dT = q/RT^2 = \beta = \text{const.}$, where $q =$ heat of reaction, $T =$ temperature (abs.), and $K =$ equilibrium-constant. This amounts to supposing that the heat of reaction varies parabolically, whilst the equilibrium- and velocity-constants vary logarithmically with the temperature. F. G. D.

1835. *Formation of Ammonia from its Elements.* **F. Haber** and **G. van Oordt.** (Zeitschr. Anorg. Chem. 44. 4. pp. 341–378, April 4, 1905.)—The authors communicate the results more fully than in their preliminary communication [see Abstract No. 1165 (1905)]. A. F.

1836. *Oceanic Salt Deposits.* XLI. *Temperature of Formation of Potassium Pentacalcium Sulphate.* **J. H. van't Hoff, G. L. Voerman,** and **W. C. Blasdale.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 12. pp. 305–310, March 9, 1905.)—The formation of this compound from syngenite and gypsum takes place at 83°: $K_2Ca(SO_4)_2 . H_2O + 4CaSO_4 . 2H_2O = K_2Ca_5(SO_4)_6 . H_2O + 8H_2O$. In presence of a solution 1,000 H_2O, 3·5K_2SO_4 (which is in equilibrium with gypsum and syngenite at 25°) the transition takes place between 25° and 50° C., as was shown by dilatometer measurements. T. M. L.

1837. *Equilibrium between a Nitrogen Base and Organic Acids in Different Solvents.* **H. F. Sill.** (Zeitschr. Phys. Chem. 51. pp. 577–602, April 25, 1905. Phys. Chem. Inst., Leipzig, Nov. 9, 1904.)—The author determines the constants of the equilibria: Cinchonine salt $\rightleftarrows$ cinchonine kathion + acid anion, and cinchonine salt $\rightleftarrows$ free cinchonine + free acid, for a number of organic acids in methyl and ethyl alcoholic solutions. T. H. P.

1838. *Equilibrium between Acetone and Hydroxylamine Hydrochloride.* **P. Landrieu.** (Comptes Rendus, 140. pp. 1392–1393, May 22, 1905.)—The author gives the results of determinations of the limit of the reaction between acetone and hydroxylamine hydrochloride and the variations of this limit with the dilution.

T. H. P.